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JOINT FORMATION AMONG THE INVERTEBRATA.

BY BENJAMIN SHARP.

The following observations were prompted by a discussion on the subject of joints, at a meeting of the Academy of Natural Sciences of Philadelphia held on November 22nd, 1892, when Prof. Cope considered some facts relating to his theory of joint formation as seen among the vertebrata.

As his theory has been known for some time, and an extended consideration of it has recently been published[1] I merely quote as a thesis, a sentence published in 1878[2]; "change of structure is seen to take place in accordance with the mechanical effect of three forms of motion, viz, by *friction*, *pressure* and *strain*."

It occurred to me that if his theory had a general application, some additional proofs could be shown to exist among the invertebrates, where we have the action of muscular force upon hard and resisting parts of the skeleton. Those which present the best study for this purpose, appear to be the crustaceans, where we find an immense variety of articulations in the body and in the limbs; highly complicated locked joints, others allowing motion in but one plane, as well as

[1]The Mechanical Causes of the development of the Hard Parts of the Mammalia, by E. D. Cope. Jour. of Morph. Vol. III, 1889, p. 137-290.

[2]The relation of animal motion to animal evolution, by E. D. Cope, American Naturalist, Vol. XII. 1878, p. 44.

loose joints, where the hard parts scarcely come in contact with one another, and cases of degeneration of the hard parts, leading to total disappearance of a previously existing joint.

In the annelides, from which, there is no doubt, the arthropod branch sprang, we find no deposit of inorganic salts in the epidermis. (I do not regard the hard, calcareous, and other secretions of tubicolous annelides as entering into this question, as they are merely protective coverings, not acted upon by the muscles of the body, nor is there even any muscular connection with it.) The outer layer of the body is generally of a horn-like character, adhering closely to the secretive cells of the epidermis, very flexible and thrown into folds by the vermicular motion of its possessor. In the leeches, the body consists of a flexible cylinder, made up of two sets of muscles, an outer longitudinal cylinder and an inner cylinder of circular fibers, the contraction of which, causes the animal to increase in length, while shortening is effected by the contraction of the longitudinal layer. The external surface of the medicinal leech, for example (see fig. 1) is thrown into a regular series of very fine folds, extending across the longitudinal axis of the body. These folds do not correspond in numbers, to the somites of the body, which are not indicated externally, five, six or more of them belonging to one somite. When the animal shortens its length, these folds are deepened and the segments thrown closely together; when extension takes place, the folds are flattened, spread open, although not wholly disappearing, as they are a fixed quantity so to speak. I believe these folds are due to mechanical action: by the disposition of the different fibers of the longitudinal series, in being inserted in a series of planes bounded by the

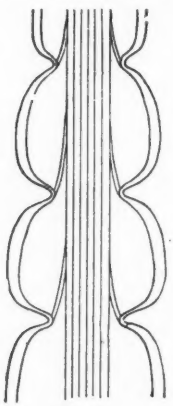


Fig. 1

Diagrammatic representation of the segments of the leech showing the folds, valleys and muscular fibers.

valleys between the folds, this being aided by some of the circular fibers which pass through the longitudinal sheath, and find their attachment to the bases of the valleys.

Starting from this point, and supposing the regularity of the folds to have become established from pre-existing irregular folds by the regularity and stress of muscular action, we can conceive that when deposits of calcareous matter took place, rings similarly formed by a folding of a soft skin would receive that deposit at the most prominent portion of this fold, the convex face and not in the protected valleys, as there would be more friction or pressure from external causes, and no deposits would take place in the valleys themselves because they would not be subject to external friction, and their continual flexion would prevent any such deposits. Should such a deposit take place in the valleys, there would be a stiffening of the whole surface which would defeat motion. In fact, in the leech, the cuticle is already much thicker on the crests of the folds than in the valleys.

In the more primitive crustacea, we find the animal made up of rings extending over the whole length of the body, similar to the rings of the leech, save (fig. 2) that there is but one ring to one somite, and instead of a perpendicular valley between the folds, this valley has an inward and a forward direction, allowing the anterior edge of a caudad ring to fit into the posterior edge of a cephalad ring.

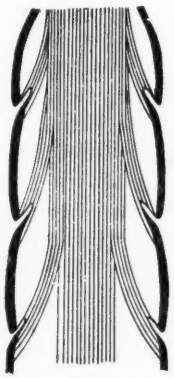


Fig 2

Diagrammatic representation of the rings of a primitive crustacea showing the action of the muscles.

In the higher crustacea, several of the anterior rings have coalesced, and form a solid shield which is known as the carapace. This has no doubt arisen by the lessening of the action between the anterior rings when the posterior portion of the body became the more active propelling organ. As the action ceased forward the valleys came to rest, and became exposed to friction and pressure, and

consequently a deposit of calcareous matter took place producing the stiffening above hinted at.

The formation of jointed appendages from parapodic paddles of the annelides can be followed out in the same manner, since the manner of mutual relation of the segments is the same as in the case of the body segments.

It has been stated that in the leech the folds do not correspond in number to the somites of the body, while they do in the crustacea. All annelides do not move by means of a muscular system built upon the plan found in the leech. In many the circular layer has to a large extent disappeared, for the longitudino-circular plan is undoubtedly ante-annelidan. The movement of the free medusoid forms, and of the Ctenophora, is the result of a modified arrangement of this plan.

With the disappearance of the circular layer, we find a peculiar modification of the longitudinal layer. This layer becomes broken up and the fibers act in moving the setæ, which answer to limbs. In a segment of a setiferous annelid, we may observe that the longitudinal muscles of the somite in section at the position of the seta are arranged like the letter "V," in the fork of which the seta lies, the fibers to the left (anterior) pull the seta externally backward, those on the right (posterior) pull the seta forward. The introduction of the setæ, the origin of which I do not here attempt to explain has no doubt been, together with the establishment of external segmentation, a strong factor in causing the breaking up of the muscular tube into sections (myotomes), which by use and consequent increase have extended each arm of the "V" into the segment on each side, while the insertion of the end of the seta has caused a break in the muscle by the formation of an aponurosis. This gives us the peculiar disposition of a myotome to extend arcoss the union of two somites.

If we examine the segments of the so-called abdomen of the macrurous crustacea, as the lobster, we will find that the anterior face of one abdominal ring is pulled into the posterior orifice of the ring lying anterior to it, forming a kind of tubular ball and socket joint, but with a flexible part of the integument with no calcareous deposit, folded upon itself,

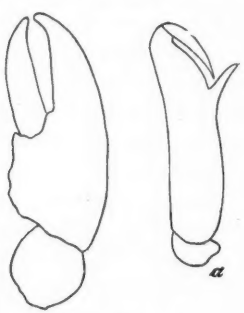
and acting physiologically as a tubular *ligamentum teres*. On examining the different joints, we will find that commencing at a fixed point, as at the base of the thorax, the movable ring of the first abdominal somite is *pulled into* the fixed part. Then the first abdominal somite becomes the fixed point for the movable ring posterior to it, and so on, so that we find that the rings proceed away from the thorax, each is pulled into the opening of the one in advance. This is true of all those forms where the abdomen is well formed, strong and an active organ in the economy of the animal; when this organ, the abdomen, ceases to be an active organ of motion as in the burrowing forms, as *Callianassa*, *Gebia*, some of the *Squillidæ*, etc., or where it is folded upon the sternum of the thoracic region, the muscles becoming weaker through disuse, the rings are not subject to the powerful muscular strain, and they as a rule overlap but little if at all, but lie so that the edge of one ring rests upon the edge of another. In those forms where degeneration of the abdomen has proceeded so far as not to have even the usual deposit of calcareous matter, as in the hermit crabs, there are simply indications of rings on the abdomen, and this organ is but little more than a fleshy sac containing some of the viscera, and supplied with a few muscles which act together, with the form of the organ, to keep the abdomen curled so that it may hold as a hook, the animal within the molluscan shell which it habitually occupies.

In forms as highly developed as the cray-fish and the lobster where the calcareous deposits are great, there have crept in many modifications. One of the main features in the articulations of the rings of the abdomen is the "lock" or hinge which allows no lateral movement in the tail whatever; the lateral movement is also prevented by the overlap of the pleura. This lock consists of a rounded prominence on each of the rings projecting *forward* from a posterior segment into a socket in the anterior one. The movement in any two segments so formed takes place in the plane, the axis of which passes through these two points so that the arc described by the movement is only in a vertical plane. The terga of the segment is much arched in the lobster, and the upward motion is limited after a certain point is reached by the dome

of the segment itself. In some of the *Scyllaridæ*, there is a transverse groove on the terga of the somites merely indicated in the lobster, into which the posterior face of the terga ahead of it fits when the abdomen is fully extended, and which prevents any further upward movement. It will be noticed further, in those forms that the sternum of each abdominal segment is very narrow, and that they are connected by a broad uncalcified membranous area which allows plenty of room for flexion downward.

The first abdominal segment is narrow, and in the vast majority of cases it is *considerably* narrower than the one which follows it so that it may be covered by the posterior edge of the carapace and the anterior edge of the second abdominal ring. In the *Homaridea* and *Loricata* there is an interesting provision to prevent the strain of the powerful abdominal muscles from drawing the smaller segment too far into the thorax. On each of the lateral faces of the ring there is a broad tooth or calcified lobe, which overlaps the posterior edge of the carapace allowing the latter to play between it and the surface of the ring.

When the limbs are examined, the same rule will be found to hold good viz.: that the movable part is pulled into the fixed part. A modification of this is well illustrated in the evolution of the large chelæ. In some forms, take for example *Ibacus*, the first pair, and in fact all of the thoracic limbs end in a sharp pointed segment, there being not the slightest suggestion of a chela. In *Crangon*, (fig. 3) on the other hand, the ternimal segment is pulled against the broad face of the penultimate one thus making a shift for a chela. In the Stomatopoda this step has been developed, for the last segment can be drawn against the whole length of the penultimate one (which is sometimes grooved to protect the points of the spines of the latter,) and forms with it a very effective grasping organ. The continual use of the terminal segment, the increase of the muscular power



b *Fig 3*

a. "hand" of a form of Crangon.
b. "hand" of a form of Astacus.

will tend to draw this terminal segment backward (into) on the penultimate which enlarges with the increase of bulk of muscle, so that a well developed chelæ, as in the lobster, is found where the ultimate segment is pulled backward to about the middle of the penultimate segment.

A true ball and socket joint rarely if ever obtains in the crustacea, and for very obvious reasons. The nature of the impassive connection of the joints would not allow of the motion and the active element, the muscle acts upon the *inside* of the joint or through its center, thus making it almost impossible for muscles to act so as to give the free movement of a ball and socket joint. The same end is obtained by a series of ginglymoid joints working in different planes so that in a series of three or four joints the end of the limb, for example, can be made to describe a circle, and I am inclined to believe that in order to obtain this free motion, the first two or three joints of crustacean limbs are as a rule very short and work in different planes.

Several objections may be easily found to the statement that posterior segments are always drawn into the anterior ones. Take for example, the shrimps, where the *second* abdominal ring *overlaps* the first so that the ring ahead of it as well as the others behind it is drawn within its anterior opening. I am inclined to regard this exception as more or less proving the rule, and to consider the second segment the fixed point into which the other two rings are drawn. We see a foreshadowing of this plan in the lobster group, where, as in *Astacus*, to use the words of Huxley, "the pluræ of the second somite are much larger than any of the others, and their front edges overlap the small pleuræ of the first abdominal somite, and when the abdomen is much flexed these pluræ even ride over the posterior edges of the branchiostegites."[3]

An exception much more difficult to explain is that found in some of the anomurous forms as *Galathea*, where the fourth, fifth, sixth and seventh segments follow the rule, and the first

[3]The Crayfish, an introduction to the study of zoology, by T. H. Huxley, New York and London, 1880, p. 98 and 99.

in regard to its anterior face, but the second overlaps the first, the third, the second, and the fourth. In other words, the fourth has pulled both ways as the second has in the shrimps, but in the latter the second segment is obviously the largest of the series, while the abdominal segments of *Galathea* are all of about the same size and strength.

We may, however, provisionally accept as a natural consequence and general rule, that the motion of a movable part naturally hollows out for itself a cavity in which to move within the solid and fixed basis. This may be further illustrated in the hard parts of the vertebrata.

It is a well known fact that even when the muscles are said to be at rest, there is more or less of a strain, or pull exerted. When the human hand hangs loosely down, it rests half way between extreme flexion and extreme extension; the same may be said of the fingers, although in some persons, as in sailors, where the flexor muscles are very strong the fingers hang as so many "hooks," owing to the pull of the more powerful flexor muscles. This is well shown in cases of the paralysis of one set of muscles; the parts are drawn to the side of the healthy muscles even when no voluntary action is exerted by the normal muscles. This is too well known to medical men to require further comment, and is especially illustrated in cases of facial paralysis where the face is drawn strongly to one side by the normal muscles.

Taking the action of the normal muscles when at so-called rest, it is not surprising to find that in the joints the lighter or more mobile part, being continually pulled against the fixed part and moved upon it, that a cavity should be formed in the fixed parts by the continual action and pressure of the mobile part. Take for example, the humerus in man, the head is hemispherical and fits into a concave portion of the scapula, a true ball and socket joint, and it is formed, if there be any truth in the idea, by the humerus being pulled into the scapula by the powerful muscles of the shoulder. And as this is probably the first joint which was formed in the evolution of the limb which then acted as a fin, the rotatory motion aided and finally established the ball and socket form

of joint. Other cases might be mentioned as that of the lower jaw and the tarso-tibial joint.

In the above remarks, I have simply made an attempt to apply the theory of mechanical genesis to a much neglected group of the invertebrata, and if I, in this, have only been able to direct attention to the field of carcinology, I will feel that this short paper will have served its purpose.

THE GASES IN LIVING PLANTS.

(*Continued from Vol. XXVII, page 7.*)

By J. C. Arthur.

Kinds of Gases and Relative Amounts.

It is now our duty to give a brief statement of the kinds, the source and the movements of gases in plants.

Plants are permeated by the same gases that make up the atmosphere surrounding them: oxygen, carbon dioxide and nitrogen. Nitrogen in the form of a gas is neither used nor generated by any part of plants, unless we except the tubercles of certain roots, and so it occurs in about the same percentage inside the plant as outside of it. On the other hand, both oxygen and carbon dioxide enter into combination with, and are liberated from, the plant tissues in varying amounts at different times. The percentage of these two gases in the cavities of the plant vary through a considerable range. In a series of determinations made by Lawes, Gilbert and Pugh, in England, the oxygen ranged from 3 to 10 per cent., and the carbon dioxide from 14 to 21 per cent in plants which had been for some time in the dark, while plants which had been standing in sunlight reversed these figures, and gave 24 to 27 per cent. of oxygen and 3 to 6 per cent. of carbon dioxide. The two gases, therefore, bear a somewhat reciprocal relation, their sum usually being about 25 to 30 per cent. of the total gas in the plant.

Variation in Amount due to Assimilation.

The variations in the relative amount of oxygen and carbon dioxide are due to two independent processes incident to the life of plants. One of these processes is assimilation, by which all green cells of plants in the presence of sunlight, or its equivalent, such as a strong electric light, absorb carbon dioxide and liberate oxygen. This process goes on with great

rapidity in healthy cells, but is entirely checked upon the withdrawal of light, or when it reaches a certain low intensity. Of course it never takes place in roots, flowers, the central portion of large stems, or other parts which are not green, nor in any fungi or other plants not possessed of green coloring matter.

Variation in Amount due to Respiration.

The other great cause of disturbance in the relation of oxygen and carbon dioxide in the plant, is the process of respiration.

Respiration in plants is essentially the same as in animals, and consists in the fixation of oxygen and the liberation of carbon dioxide. It takes place in every living cell, whatever the kind of plant, whatever the part of the plant, and whatever the conditions of active existence. The rate of respiration varies with the temperature, the age of the cell, and the nature of the chemical transformations. In normal respiration the amount of oxygen absorbed is approximately the same as the amount of carbon dioxide evolved. There are, however, certain modified forms of respiration in which this does not hold true.

If living plants be placed in a vacuum, or in an atmosphere deprived of oxygen, it is found that they can still carry on life processes for some time, accompanied with an evolution of carbon dioxide. The oxygen necessary for this process is obtained from the breaking up of compounds in the cells, and it is therefore called intramolecular breathing.

The germination of seeds, which contain a large amount of oil, is somewhat the opposite of this last process. In order to convert the fat into a more directly servicable food material for the plant, a large amount of oxygen enters into the new combination, for which there is no equivalent amount of gas liberated. It consequently comes about that oily seeds in germinating absorb a far larger amount of oxygen than they liberate of carbon dioxide. This is known as vincular breathing.

Another variation from normal respiration is known as insolar breathing, and which, with still some other modifications, I need not stop to explain. To this brief statement of plant respiration must be added that much yet remains to be discovered regarding the details of the processes.

Assimilation and respiration are the two great causes which disturb the relative volume of the two variable gases in plants.

Movement of the Same two Gases.

We shall now turn to the movement of the same two gases, oxygen and carbon dioxide. There has never been a disposition, as in the case of many other plant phenomena, to explain the movement of gases upon any other than purely physical principles. We have therefore to do simply with the question of the aids and hindrances to the establishment of an equilibrium between the gases inside and outside the plant, irrespective of whether the cells are alive or dead.

Outer and Inner Pressure of Gases.

It has already been stated that the relative amounts of oxygen and carbon dioxide inside the plant are usually very different, and that within a few hours the relation of the two may be completely reversed. To this may be added that the pressure of the gases inside the plant is sometimes more, sometimes less than that of the atmosphere outside the plant, almost never the same. Hales observed in his early work that a mercury guage connected with the inside of the trunk of a tree showed an internal pressure when the hot rays of the sun warmed the trunk. This was largely due, undoubtedly, to the expansion of the gases in the trunk, by the heat. Such an excess of pressure in water plants is very common, although due to other causes. It may readily be shown by breaking stems under water, when bubbles of gas will be liberated, as undoubtedly many have noticed in gathering water lilies, or other water plants.

On the other hand, the pressure of the gas inside the plant may be less than on the outside. This has long been recog-

nized, but was best demonstrated by von Höhnel in 1879, to whom it occurred to cut off stems under mercury. In doing so the mercury rose to a considerable height in the vessels of the stem, and as mercury is without capillarity, this can only be ascribed to the greater pressure of the outside air, or in other words, to a partial vacuum in the plant.

An observation was made by Hales, whom I have mentioned so often, which we may use to illustrate how such a negative pressure, as it has been called, can be brought about. He cut off a branch, fastened an empty tube to the cut end, and plunged the other end of the tube into a liquid. He found that as evaporation of moisture from the leaves took place, the liquid was drawn up into the empty tube. This phenomenon can now be explained more satisfactorily than could be done at that early day. By evaporation the liquid water inside the plant escapes in the form of vapor, and the space it occupied is filled by the gases, thus rarifying them. This rarifaction may go on in uninjured plants until the internal pressure is greatly reduced. But in the experiment, the pressure is equalized by the rise of the liquid in the tube. A later modification of Hales' experiment is to use a forked branch, place the cut end in water to give a continuous supply of moisture for transpiration, and attach the empty tube to one of the side forks of the stem, cut away for that purpose.

Permeability of Tissues.

It is self-evident that such condensation and rarifaction of the gases in the plant could not take place if the cell walls were readily permeable to gases. Thus it comes about that one of the most important topics in connection with the movement of gases in the plant, is the permeability of tissue walls of various kinds, and especially those constituting the surface covering of plants.

I shall not attempt to conduct you through the tangle of supposition and fact, errors in experiments, correct and incorrect conclusions, and the general confusion which has come from the labors of physicists, chemists and botanists for the last twenty-five years, during which the subject has received

particular attention. The results of the later work have been to cast grave doubts upon the correctness, or at least the interpretation of some of the experiments most relied upon heretofore. Nevertheless many points still lie open for verification, and untouched parts of the subject await investigation.

Movement Through Surface Openings.

In the earlier days it was found that the leaves and young stems of plants have their epidermis more or less well supplied with minute openings, called stomata, or breathing pores, which communicate with small air cavities inside, which in turn branch out among the cells into a net work of minute passages rarifying throughout the plant. This intricate net work of intercellular passages affords an air communication throughout the whole plant, and connects directly with the outside atmosphere through the stomata. Subsequent to the discovery of stomata, it was ascertained, that in stems more than one year old, the stomata are replaced by another kind of opening, known as lenticels, which in some form are doubtless to be found in the bark of shrubs and trees of whatever age.

Gases stream into and out of the plant through the stomata and simpler lenticels, according to the law governing the movement of gases through minute openings in thin plates. The rate of movement is accordingly proportional to the square roots of the density of the mixing gases. Such a movement of gases is known as effusion.

Movement Through Internal Passages.

The movement by which gases pass from one part of the plant to another, through the intercellular spaces, is governed by other laws. It was at first thought that the rate of movement would correspond to that in capillary tubes, according to the well known law of Poisenille, that it is proportional to the fourth power of the diameter, divided by the length of the tube. But upon testing the matter two years ago, Wiesner found that owing to the extreme minuteness of the intercellular spaces, and their zigzagged and branched condition, this

law does not hold, neither does the movement prove to be proportional to the density of the gases. The discovery of the law of the rate of movement of gases in intercellular spaces, that is, the transpiration of gases, is, therefore, yet to be discovered, together with other interesting facts pertaining to the subject. Poisenille's law does, however, hold good for the movement of gases in the woody ducts, but here it is of limited application, for these do not connect with one another, with the intercellular spaces, or with the exterior of the plant.

Movement Through Cell Walls.

The walls of most cells, ducts, and surface covering of plants, except as already mentioned, are imperforate, that is without any openings that can be demonstrated by the microscope. If gases pass through them, it must be in accordance with some law of diffusion, or osmosis. Many experiments in this line have been tried, and the results have been of the most diverse character. It is impossible to give a fair idea of the subject in the time at my disposal, and it must suffice to mention a few bare facts.

The most astonishing and important results were obtained by Wiesner, in experiments conducted at Vienna, two years since. It would be a most natural interpretation, it seems to me, to think that the gases are forced from one cell to another, through the cell walls by differences in pressure. Wiesner found, however, that it is impossible to force gases through cell walls of any kind whatever, by any pressure they will stand, acting for any length of time. For instance, a bit of grape skin held up a column of mercury, 70 centimeters high, for 75 days, and a piece of cherry skin withstood a pressure of 3 atmospheres for 24 hours. Similar experiments were tried with cuticularized, suberized, liquified and simple cellulose tissues from many sources, and with uniformly the same results, whether the tissues were moist or dry, alive or dead.

But in the same set of experiments it was found that if gases cannot be forced through cell walls, they will readily pass through by simple osmotic diffusion. All cells permit the passage of gases by diffusion when moist, dependent upon the

coefficient of absorption and the density of the gas. Cuticular and corky formations also permit the passage of gases when dry. Thus we see, that gases may be forced through the stomata, or breathing pores, by varying pressure, but can only pass through the epidermis and bark of plants by diffusion. We therefore arrive at the conclusion that the gases inside and outside of the plant are brought to an equilibrium by direct interchange through the stomata and intercellular spaces, aided by the comparatively slow process of diffusion through the whole surface of the plant, both above and below ground.

In Conclusion.

After so long a discussion of the subject of the origin, kinds and movement of gases in plants, I trust I have not only brought out the main facts regarding our present knowledge, but also made evident some of the numerous directions in which further experiment and research is needed. It would be most appropriate to transfer the activity in this subject to the laboratories of this country, and let the Americans take up the line of discoveries carried on so far by the English, French, and lastly, the German scientists.

LEGENDS OF THE SUMIRO-ACCADIANS OF CHALDEA.

By Alice Bodington.

(*Continued from Vol. XXVII, p.* 19.)

In Genesis, as is well known, two distinct accounts exist of the creation of the world and of Man, of which variants are found in the cuneiform inscriptions. One of these variants, lately found on a tablet of baked clay, with a parallel Semitic translation, is of great interest. It begins at an earlier period of cosmic history than either the Biblical or the hitherto known Chaldean account.[1] Whilst the version of the first chapter of Genesis[2] begins with a description of chaos and the old Semitic Babylonian version with the time "when the heavens were not proclaimed and the earth recorded not a name," the Sumiro-Accadian account begins with a description of the time when the "glorious house of the gods (apparently the sky,) had not been made, a plant had not been brought forth nor a tree created; when a brick had not been laid, a beam not shaped, a house not built, a city not constructed and a glorious foundation or dwelling of men had not been made." But when "within the sea there was a stream," then "the glorious city of the gods, the divine Eridhu," was built, of which Babylon, the earthly Eridhu, was a faint copy. Then the tablet mentions the creation of living beings, not men as yet, but gods and the spirits "Anunnaki"; and the supreme deity proclaims the existence of the "glorious city, the seat of the joy of their hearts." Meridug, son of Ea, now "made a foundation before the waters"; made dust and poured it out with the blood, and in one single line "he made mankind." The female principle, the goddess Araru, (the Bohu of Chaldean legend the Bohu of Genesis 1.2) "made the seed of mankind with him."

[1]That deciphered by George Smith.

[2]New Version of the Creation Story. Paper read by Mr. T. G. Pinches, of the British Museum, at the International Oriental Congress.

Then he made the beasts of the field and the living creatures of the desert; the Tigris and the Euphrates, and "proclaimed their name well," in fact said that creation was good, as in Genesis. Then Herodach created grass, the plants of the marshes and the forests; and with the plains and forests in which they were to dwell, he made oxen and other large cattle and sheep. This deeply interesting account has been necessarily much abbreviated.

The Accadian idea of the structure of the world must be understood before the various legends as to the creation and the early history of mankind become "thinkable" to the modern mind. In our mind's eye we see the world as a comparatively insignificant planet whirling at headlong speed round a central sun; we know the blue sky to be only the effect of distant air; it is not "thinkable" to us that the sun should stand still at the bidding of the leader of a small tribe of half savage Nomads, nor that a tower should be built to attain a solid sky, above which lived gods, alarmed and jealous at so daring a proceeding. Nor can we picture to ourselves a great reservoir or "Heavenly Ocean" above a solid sky, which could be "opened" to let the waters submerge a sinful world. But all these stories are in harmony with Accadian cosmogony. The Chaldeans imagined the earth as an inverted boat or bowl, the thickness of which would represent what we call the crust of the earth; while in the hollow beneath this crust lay the "abyss," the abode of many powers, and answering to the Elysium and Tartarus of classic mythology. Here dwelt Allat, the remorseless Queen of the Dead; from the Abyss issued the terrible Maskim, the seven evil spirits, who knew neither mercy nor pity.[3] Here too was Eridhu, the "glorious abode," within which was the tower which reached the skies.

Above the convex surface of the earth spread the sky, (*ana*) divided into two regions, the highest heaven or firmament, which with the fixed stars immovably attached to it, revolved as upon an axis, round an immensely high mountain, which joined it to the earth as a pillar. In the lower heaven the planets conceived of as resplendent animals of beneficent

[3]Chaldea, pp. 153–157.

nature, wandered forever on their appointed paths. The earthly ocean, a counterpart of the heavenly ocean, was imagined as a broad river, or watery rim, flowing all round the edge of the inverted bowl, precisely as Herodotus described it. And so late as the Middle Ages, we find Dante's conception of the structure of the world to be substantially that of the Accadians; the "purgatorio" is an immensely high mountain joining earth and sky, through whose circles pass the souls in a state of probation, till at the top they step into the lower heaven.

In the fine Accadian epic of which the account of the Deluge furnishes the eleventh book, the ark is represented as resting on this mountain. It relates[4] that Tzdubar, the national hero, was beloved by the goddess Tshtar. She promised him a "chariot of gold and precious stones; that kings and princes should bow before him, and kiss his feet; that his flocks and herds should multiply two fold, and his mules and oxen be peerless of their kind." But Tzdubar laughed her love to scorn, and the enraged goddess implored her father, Anu, to take vengeance on him. A monstrous bull was sent against his city of Erech, but it was slain by Tzdubar's friend, Eâbani, and laid before the altar of the god Shamash, whilst the people spent the night in feasting and rejoicing. But the vengeance of Tshtar was not to be so easily foiled. With the help of her mother she smote Eâbani with sudden death and Tzdubar with a dire disease, which made life a burden. He determined in his anguish to seek relief from his great ancestor, Hâsisadra, who dwelt, immortal, in the Blessed Land, at the "mouth of the rivers" beyond the Waters of Death. Long and weary was the journey, and on his way Tzdubar passed the giant warders of the sun—half men and half scorpions—who kept watch over his rising and his setting. On the shore of the Waters of Death the hero met the ferryman Urubél, and for a month and fifteen days they journeyed together over that dreary sea, till they reached the Chaldean "Valley of Avilon," and Tzdubar met his ancestor face to face. Here Hâsisadra related to his descendant the story of the Deluge, and his own

[4]Chaldea, pp. 301–17.

share in that great event. Tzdubar was purified and healed by laving in the Waters of Death; he returned safely to Erech, and there offered up a touching prayer to the beneficent god, Ea, that his lost friend, Eâbani, might be restored to life. Ea, through his son, Meridug, brings Eâbani from the world of Shades to the Land of the Blessed, there to live forever among the heroes of old, and so all ends happily as a fairy tale.

The Chaldean legend of the Deluge is, as is well known, an extremely close variant of the account found in Genesis, even to the rainbow as a sign of the repentance of the God Anu, for the havoc he had wrought. Only it is Tshtar who "spreads out the great bows of her father Anu," and who says "I shall be mindful of these days; never shall I lose the memory of them," and the assurance is given that though pestilence and wild beasts may be sent as a punishment for the wickedness of man, never shall a universal flood again overwhelm the earth. In the Chaldean account it is the ever beneficent Ea who warns Hâsisadra of the coming flood, and bids him prepare the ark for himself and his family, and who himself sends the cattle and the wild beasts of the field to their haven of safety; he who reproaches the other gods with the wanton destruction they have wrought, and brought Bel, hasty but quickly repentant to his senses. Bel himself took Hâsisadra by the hand and led him out of the ark, after the sacrifice had been offered up, "when the gods smelled a sweet savour." See Genesis viii, 21.

The great solar and catholic myths are found in their earliest forms amongst the Sumiro-Accadians, and from them they passed through the Phœnicians to the Greeks and Romans. Tshtar, the great goddess of Nature, personifying the life-producing earth, loves the young Sun-God, Dumuzi. The tablet of the national Epic, which describes the manner of his death, has unfortunately but one fragment left, which speaks of the "black pine of Eridhu, marking the centre of the earth, in the dark forest, into the heart whereof man has not penetrated; within it Dumuzi. . . ." A month was set apart, (June–July), both in Chaldea and Assyria, as

mourning for the death of Dumuzi, however it occurred; the mourners wept and wailed, and tore their hair for the first six days, and at the close of the sixth day the wildest and most extravagant rejoicing marked his resurrection and restoration to Tshtar. Six hundred years B. C., Ezekiel, in captivity at Babylon, speaks of the "women weeping for Tammuz," (Dumuzi). We have, fortunately, the tablet, nearly complete, which relates Tshtar's descent to "the land whence there is no return, towards the dwelling that has an entrance but no exit, towards the hall from which the light of day is shut out, where the shades of the dead dwell in the dark." Tshtar haughtily orders the warder to open the gate, "If thou openest not, I will demolish the threshold. . . . I will let loose the dead to return to earth. . . . I will make the risen dead more monstrous than the living." The gatekeeper humbly answers the angry goddess: "Be appeased, O Lady, let me go and report thy name to Allat, the Queen." And Tshtar declares that she comes only to "weep over the heroes who have lost their wives; over the wives who have been taken from their husbands' arms. I wish to weep over the Only Son, (a name of Dumuzi,) who has been taken away before his time." Allat, full of evil delight that a hated rival has come within her power, orders the keeper to open the seven-fold gates for Tshtar, with the stipulation that at every gate she should strip off some of her attire. The warder of Arallu takes from the goddess her earrings, her necklace, her jewelled girdle, the bracelets on her arms, and the bangles at her ankles, and lastly her long flowing garment, and with these her divine power departed, and she stood powerless before the spiteful Queen of the Dead. Allat orders her chief minister, Namtar, the Pestilence, to lead Tshtar away, and to afflict her with sixty dire diseases, in the deepest darkness of the abyss. Meanwhile, as when Demeter mourned inconsolably for her lost Persephone, all went ill in the upper world. Life and love had gone out of it; there were no marriages and no births, and the gods held council as to the release of Tshtar. The beneficent Ea conceived a plan. He created a phantom, Uddusunamir. "Go," he said, "to the Land whence

there is no return, and the seven gates of Arallu will open before thee. . . . Conjure Allat with the name of the great gods; stiffen thy neck and keep thy mind on the Spring of Life. Let the Lady (Tshtar) gain access to the Spring of Life, and drink of its waters." Allat in her fury beat her breast and bit her fingers with rage. She ordered Namtar to let Tshtar drink of the Spring of Life, and bear her from her sight. Namtar took the goddess through the seven enclosures, restoring at each the article of her attire that had been taken from her. At the last gate he said: "Thou hast paid no ransom to Allat for thy deliverance; so now return to Dumuzi, the lover of thy youth; sprinkle over him the sacred waters, clothe him in splendid garments, adorn him with gems." The last lines of the poem are mutilated, but it is evident that they bear on the reunion of Tshtar with her young lover.

Not only does this myth remind one of the legends of Demeter and Persephone, of Adonis, of Balder, the beautiful, and of Osiris, but what—if it were possible—seems like a variant of the same myth, is the legend amongst the Tee-Wahn[5] Indians of Nah-chu-ru-chu (the Bluish Light of Dawn) and his lost wife, the Moon-maiden. Nah-chu-ru-chu held the well-being of all his people in his hands for life and death. When the jealous Corn-maidens had thrown his wife down a deep well where none could find her, Nah-chu-ru-chu sat for days, neither speaking nor moving, his head bowed upon his hands. Then no rain fell and the crops died, and thirsty animals wandered, crying along the dry rivers. The coyote, the badger and the eagle went to seek the lost Moon, and when at last she was found, the choked earth drank and was glad and green, the dead crops came to life, and for four days the people danced and sang in the public square.

In innumerable ways have the Accadians been the priests and schoolmasters of mankind in Europe and Asia, for through the Bâk tribes of Elam, in Southern Chaldea, they are considered to have been the founders of the ancient civilization of China; and through the Semitic peoples they have conferred upon us gifts, good and bad; the art of writing, the signs of

[5]Tee-Wahn Folk Stories. St. Nicholas, March, 1892.

the zodiac, the measurement of the year, the early legends of Genesis, the keeping sacred of the seventh day, the belief in magic and witchcraft, and the mediæval devil. An Assyrian calendar mentions a day called Sabattu, "a day for completion of work, of rest for the soul." On that day it was not lawful to cook food, to change one's dress, to offer a sacrifice; the king was forbidden to speak in public, to ride in a chariot, or perform any civil or military duty"; a strictness equal to the Sabbatarianism of the most orthodox Jew.

On their way to a pure monotheism, the early Jews seem to have combined in their "Elohim," and their "Yahveh," the characteristics of the principal gods of the Sumiro-Accadians. We recognize the features, sometimes of the calm and beneficent Ea, and of his son Meridug, Intercessor for men; sometimes of the hasty, vindictive Sun-god, Bel, who "consumes in a moment" the victims of his anger, till the features of all these Nature gods fade away in the moral effulgence of the sublime God of Isaiah.

No object is commoner in Chaldean and Assyrian pictorial representations than the Sacred Tree, the Tree of Life, with and without the serpent. To the old Chaldeans the Sacred Tree was intimately connected with an original ancestral abode, an earthly Paradise, watered by springs which became great rivers.

The "serpent of Genesis we recognize as Mummu-Tiamat," the "Dragon," the "Great Serpent," who was the sworn enemy of the gods and their creation; the principle of opposition and destruction. The gods determine to fight the great Serpent; Anu, the heaven God, prepares the sickle-shaped sword, and the beautifully bent bow, whilst Bel goes forth in his matchless war-chariot, sending the lightning before him, and scattering his arrows around. Tiamat comes forth to meet him, attended by evil demons, and bearing death and destruction in her train. But it is Meridug, the intercessor for mankind, who "bruises the serpent's head"; who binds her and puts an end to her works, while her followers fly terror-stricken.

I have not space to give a tithe of the profoundly interesting and suggestive facts revealed by the deciphering of the cune-

iform inscriptions. We find ourselves looking at the cradle-land of our religion, our sciences and our literature; we find the most touching and passionate appeals to the Divinity in the very spirit of the finest Psalms of David, in a land looked upon as the seat of the grossest idolatry; we find a civilization old enough to have been the parent stock of the civilization of China; we look upon an early world, which knew nothing of the proud white race which now girdles the earth with empire.

Amidst the surging waves which have carried away so many beliefs, we find two anchors linking us to the Unseen, which become the firmer the more we know of evolutionary processes. One is the enormous strength of the religious instinct, even at the earliest stages of the civilization of mankind. And if the study of evolution teaches us one thing more than another, it is that *no instinct exists in vain.* The other foreign to my present subject is the inscrutable nature of the "*noumenon,*" which lies behind all phenomena; that Energy, which, whether we think of it as "gods" with the old Accadians, as the "Supreme Being," or by whatever name we strive to approach the Unknown Reality, it remains equally Unknown, (though perhaps not forever Unknowable,) and equally the eternal object of search and worship.

CERTAIN SHELL HEAPS OF THE ST. JOHN'S RIVER FLORIDA, HITHERTO UNEXPLORED.

By Clarence B. Moore.

(*Continued from January Number, 1893.*)

(*Second Paper.*)

West end of ridge on summit, 7x4x7½ feet deep. At a depth of 1 foot 6 inches, an arrow-head with bones of lower edible animals, was found. Two feet down were fragments of turtle shell, and a half a foot lower, a fragment of a bone awl was met with. At 5 feet, 6 inches, from the surface was a well defined fire-place, with bones of the turtle. The shells are almost exclusively *Paludinæ*, with occasional *Unionidæ* and few *Ampullariæ*.

EXCAVATION II.

North-east side of mound about ten feet vertically from the base. Besides the usual fire-places and bones of edible animals, a fragment of a *Fulgur* was found at a depth of four feet.

EXCAVATION III.

On summit near center of ridge, 9x9x11 feet deep. No clearly marked strata were met with, the excavation being carried through shell with a considerable percentage of broken shell and sand. The following objects were found;—flint flake at a depth of 6 inches; fragment of bone awl 1 foot down; small pendant ornament of shell 1½ feet from surface, (Fig. 4)

Fig. 4. Size, ½.

with bone implement; shell gouge (broken) 2 feet down; rude arrow-head on fire-place, 4½ feet down; flint flake 5 feet down; arrow-head lying on fire-place, at a depth of 6½ feet from surface; portion of arrow-head on fire-place, bearing marks of fire at a depth of 8 feet; fragment of bone awl 9 feet 9 inches down; rude bone awl 10 feet down; bones of edible animals, mainly of alligator, deer and turtle, at all depths.

EXCAVATION IV.

At margin of base north-east portion of mound. Trench 11½x10x6 feet deep at end. A piece of coquina, smooth on one side, evidently used for polishing, at a depth of 2½ feet, and a fragment of arrow-head with the usual bones of edible animals, were the only objects of interest met with.

As before stated, absolutely no pottery was seen in the excavation, and this, with the 600 feet of swamp between the mound and the river, would argue for Mt. Taylor a place among the earliest shell heaps of the St. John's. It was the habit of the builders of the shell heaps where solid ground was to be found, to locate their refuse heaps upon it, and it seems unlikely that a spot so far distant from the river's edge as is Mt. Taylor to-day, should have been selected. It is a much more likely hypothesis that the swamp is the result of a change of channel in the river, and has formed since the abandonment of the mound. Professor Wyman has graphically described in his memoir (page 83 et. seq.) the manner of formation of similar swamps. The time required to transform a portion of the river into swamp-land, the writer of this paper believes to be somewhat less than is generally supposed, owing to the great abundance of floating vegetation upon the river. At Little Orange mound, opposite Lake Dexter, is a steam boat wharf in use within eight years, according to the owner of the place. At present, masses of vegetation extending some distance into the river have made access impossible for a boat of any draught, and are speedily forming the nucleus of a future swamp.

Assuming this hypothesis of the formation of the swamp after the completion of the mound to be correct, an indication

of minimum age may be obtained in the case of Mt. Taylor through the size of trees growing between it and the water's edge. Between it and the river grow two cypresses, respectively 14 feet in circumference four feet from the ground, and 19 feet, 3 inches, 5 feet from the ground; while a little to the north-west of the mound in the swamp grows a cypress 23½ feet in circumference at a height of 5 feet from the ground. The cypress is a tree of slow growth, by some being placed next to the live oak in this respect.

Another point illustrated by Mt. Taylor is that neighboring shell heaps are by no means of necessity contemporary. In close proximity to it in the river, is Bird's Island,[1] covered with a shell deposit between five and six feet in thickness. Throughout this deposit to the very bottom unornamented pottery is found in great abundance. North of Bird's Island, on the western bank of the river, is the shell bluff described by Professor Wyman (Note A.). This shell bluff, by the absence of pottery and the small size of its *Paludinæ*, differs widely from Bird's Island, and is probably contemporary with Mt. Taylor.

Just what impelled the makers of Mt. Taylor to pile the debris of their meals to such a height and at such an angle it is impossible to surmise. No ridges of shell led to it, while no shell fields surround it, and it is evident that great care was taken looking to its isolation and to give to it its height and shape. In comparison with the shell deposits of Huntoon Island, of Bluffton, of Silver Spring (Lake George), of Tick Island and other localities where the shell deposit, though large, is spread over great areas and not piled at a single spot, the contrast is especially striking.

Shell Deposit Opposite Bluffton.

On the west bank of the river, opposite Bluffton, is a level deposit of shell bordering the water. About fifty yards inland is a small symmetrical mound, not over three feet in

[1]The *Paludinæ* on Bird's Island, it may be remarked, are far larger than any found at Mt. Taylor; well illustrating a point stated in the preceding paper that shell fish of the St. John's had a middle period of increased development, and a subsequent relapse to their earlier condition.

height, composed of the same material as the shell deposit, namely shell and powdered shell. An excavation was made in the center of the mound, and within a foot of the surface were found various parts of a skeleton, apparently of a woman. The jaws and all other facial bones were missing, as were one femur, one humerus, both tibiæ and all bones of the feet. Many of the bones had fractures not caused during the excavation, the area of the fracture being of the same color as the remainder of the bone. With the remains were several bits of pottery which seemed to be wanting in the mound, save in association with the bones, and this fact would indicate a burial, as would the symmetrical shape of the mound. The fractures can readily be explained by the proximity to the surface, where the tramping of feet could without difficulty separate and fracture the bones. On the other hand, the absence of so many important bones—for which very careful search was made—would seem to indicate that the entire body was not placed within the mound. The various conflicting facts connected with this case offer one of those questions, unfortunately without solution, which from time to time confront the explorer of the shell heaps.

Near this point Mr. Dease, of Volusia, found a small earthenware bowl clinging to the roots of an overturned palmetto, and presented it to the writer.

NOTE A.

AS TO A NATURAL ORIGIN OF ANY OF THE FRESH-WATER SHELL HEAPS OF THE RIVER.

It will be remembered that at the time when Professor Wyman wrote, the agency of man in connection with the shell heaps of the St. John's was nowhere admitted. It is therefore quite natural that taking the initiative in this matter he should have been averse to making any sweeping assertions. There is, however, little room to doubt that all the shell heaps are the work of man. Of the shell bluff near Astor, (Fort Butler) he says[2] (page 38) "taken by itself, in view of the

[2] *Op. cit.*

absence of human implements we should hardly feel justified in saying that it was made by man; though in its general features it resembles his work." At the base of this bluff the writer picked up a chisel of shell, and, what is more conclusive (since objects not in place prove but little) a clearly defined fire-place was discovered at a depth of four feet from the surface. It is perfectly safe to say that no fresh-water shell heap can be found on the St. John's River where a careful search would not reveal unmistakable evidences of human agency in its origin.

THE ANCYLOPODA, CHALICOTHERIUM AND ARTIONYX.[1]

By Henry Fairfield Osborn.

Chalicotherium was the most unique mammal of the Miocene period. So far as known at present, it combined cheek teeth of a distinctively ungulate type, ankle and wrist joints resembling those of the Perissodactyla, with highly modified phalanges, terminating in large cleft ungues which were undoubtedly covered with strong pointed claws. It was widely distributed over Europe, Asia and North America from the oligocene Phosphorites of France (*C. modicum*) to the early Pliocene of the Siwalik Hills (*C. sivalense*).

The recent discoveries of Filhol and Depéret in France have fully revealed the structure of the skull and limbs, but with the exception of the axis, little or nothing is known of either the vertebræ or scapular and pelvic arches. As we learn from these authors the *Chalicotherium magnum* of Sansan (Middle Miocene) was an animal taller than the grizzly bear. The head was about nineteen inches long and raised five feet above the ground. The limbs were rather slender, and a striking peculiarity of this species is that the fore limb is nearly twice as long as the hind limb (as indicated by the proportions of the radius and tibia). This was not the case in its upper Miocene ally (*Ancyllotherium pentelici*) from Pikermi, in which the limbs were heavy and of the same length. There were three toes upon each foot, but in both manus and pes, the fourth or outer digit was the largest instead of the third or middle digit as in the Perissodactyla. M. Filhol has represented *C. magnum* as fully plantigrade, but this appears to me an error; the perissodactyl displacement of the carpals and

[1] Under the title "The Affinities of *Chalicotherium*," this article was written some months ago. While it was in press, *Artionyx*, a new type of the order was discovered, and at the editor's suggestion, the article was held back to include a description of it.

tarsals, the structure of the ankle and wrist joints, and the terminal facets of the metapodials all indicate that the feet were sub-digitigrade. Displacement is very rare in plantigrade types. The proximal phalanges are peculiar in having the metapodial facets directed obliquely upward; both these and the median phalanges are short; the distal phalanges are very peculiar, they present a deep terminal cleft and were evidently drawn up or retracted, as in the cats, instead of being drawn down or flexed, as in the Edentates. Thus, it is probable that *Chalicotherium* walked more like a clumsy-footed cat than like the bear. The soles of the feet were slightly turned inward and the fore-limb was adapted to digging or partial prehension.

Restoration. The axial skeleton in the accompanying drawing is mainly based upon Filhol's restoration, but the scapula and pelvis are independently restored upon the perissodactyl model; the sloping trunk leads us to expect a rather broad pelvic basin. All the above parts are purely conjectural.

The proportions of the fore and hind limbs with each other and with the skull are based upon the figures of Depéret. In Filhol's drawing the skull is proportionately too small. The side views of the feet are after Filhol's excellent drawings, but the articular positions are drawn differently, for M. Filhol makes the animal fully plantigrade, while the metapodial and phalangeal and higher articulations prove that it was digitigrade.

What is the explanation of this remarkable assemblage of characters? Where shall we place Chalicotherium, with reference to the two great orders between which it seems to stand midway. If, observing the teeth and the carpus and tarsus, we relate it to Perissodactyla, we find ourselves placing a clawed type among hoofed types. Or is it to be considered an Edentate because of its claws and edentulous premaxillaries as Filhol has suggested? Or is it representative of a distinct order midway between the Ungulata and Unguiculata? It is too early to attempt a final solution of these questions. We must wait for the discovery of the middle and upper Eocene Chalicotheriidæ. It is evident from Gaudry's discovery of the

feet in the Phosphorites, *C.* (Schizotherium) *priscum*, that the finding of other Eocene types is not far off. In the meantime I have tentatively offered the suggestion that *Chalicotherium* is

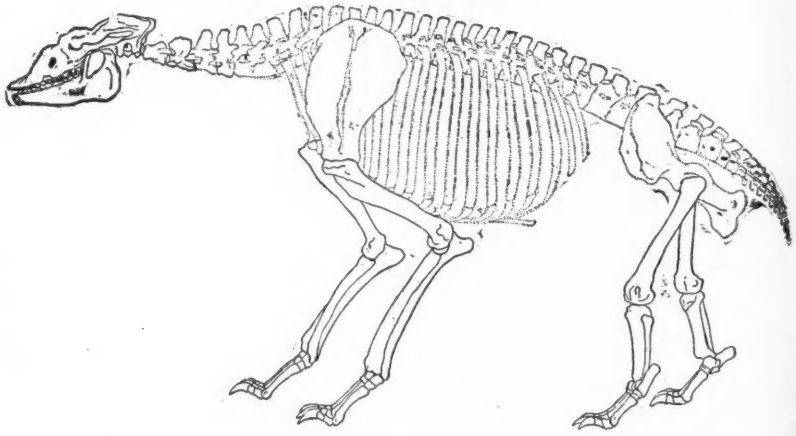


Fig. 1. Restoration of *Chalicotherium*. Modified from Filhol and Depéret.

distantly related to *Meniscotherium* of the lower Eocene (Wasatch), and that this may give us a clue to its zoological position. I will now expand and discuss this idea which may be expressed as follows:

That the group to which Chalicotherium belongs was derived from the Condylarthra of the lowest Eocene, with affinities to the Meniscotheriidae and primitive Perissodactyla. It represents a distinct order, the Ancylopoda (Cope). The likeness to the Unguiculates and especially to the Edentata is due to secondary adaptations and contains no proof of real affinity.

The *history of the discovery* of this animal is as unique as its structure, and illustrates the uncertain path of the vertebrate paleontologist. We are indebted for a full résumé, to Dr. Ch. Depéret, who has fully discussed the bibliography, structure and relations of this genus in his admirable memoir. Until

recently the skull and limb bones, wherever found, were placed not only in different genera but in distinct orders. The first remains discovered were the terminal phalanges, found in the upper Miocene of Eppelsheim in 1825; they were sent to Cuvier, who, noting the deep terminal cleft, named them *Pangolin gigantesque.* In 1833 Kaup found in the same beds the isolated upper molars which he naturally attributed to an ungulate, and named *Chalicotherium goldfussi* (syn. *antiquum*). Thus early began the confusion due to the wholly diverse affinities suggested by the phalanges and the teeth. In 1837 Lartet found the feet (in somewhat earlier Miocene beds of Sansan) which he supposed belonged to a huge edentate and termed *Macrotherium giganteum.* In 1853 Lartet also discovered a skull and teeth at Sansan; he was unaware of Kaup's priority and first called the skull *Anoplotherium*, but later separated it as *Anisodon*; Gervais, later, pointed out the priority of Kaup's term. In the upper Miocene of Pikermi Gaudry found feet and limbs quite different from the *Macrotherium* type; these he termed *Ancylotherium.* From the Phosphorites, in 1875, he described the teeth of a new species, *C. modicum*, and the feet of a supposed new genus, *Schizotherium priscum.* The skull and teeth were also found by Falconer in the Siwaliks of India and termed *C. sivalense.*

Considering this exceptional mingling in so many horizons, of one genus represented exclusively by skulls or teeth and another by feet and limbs, Filhol, in 1888, first advanced the conjecture that the two might really be one, and was happily able to confirm this by his own discoveries in Sansan. Forsyth Major independently arrived at the same conclusion from his explorations in the Pikermi beds. Finally, in his memoir, Depéret describes parts of a skeleton and skull found together at Grive St. Alban, in beds nearly contemporaneous with Sansan. In the meantime it is probable that a similar confusion has arisen with us. In 1877 Marsh announced the discovery of phalanges of a large edentate in the middle and upper Miocene of Oregon and Nebraska, and compared them with those of *Ancylotherium* rather than with any true edentates; he distinguished them by the coalescence of the first and sec-

ond phalanges as *Moropus* (species *distans, senex* and *elatus*). The first undoubted remains of *Chalicotherium* in this country were found by Garman in the Loup Fork (upper Miocene) and described by Scott and Osborn. Cope has also described a lower Miocene species (*C. bilobatum*) from the White River beds (Swift Current Creek) of Canada. It is not improbable that *Moropus* belongs to the same types.

Nomenclature and Synonomy. Depéret advocates an important modification in our nomenclature. He believes that the Eppelsheim type, to which the name *Chalicotherium* was originally applied, can be identified by the form of its phalanges with the Pikermi type (*Ancylotherium* Gaudry), and is, therefore, distinct from the Sansan type. For the latter he proposes to retain the name *Macrotherium* Lartet. If this proves to be correct these types should be distinguished as follows:

Middle and Lower Miocene. (Sansan, Grive St. Alban, ? Phosphorites.)	Upper Miocene, Lower Pliocene. (Eppelsheim, Pikermi.)
Macrotherium.	*Chalicotherium.*
Syn.: Anisodon, ? Schizotherium, ? Moropus.	Syn.: Ancylotherium.
Semi-arboreal and fossorial. Light skeleton. Fore-limb greatly elongated. Radius (= .70), tibia (= .29). Radius with large external, and small internal, fossa for humerus. Ulna distinct or very slightly coalesced with radius distally.	Quadrupedal. Heavy skeleton. Fore- and hind-limbs nearly equal. Radius and tibia of nearly same size; of heavy proportions. Radius with subequal external and internal fossæ of humerus. Ulna coalesced with radius.

While many striking differences separated these two types, especially in the proportions of the limbs, the teeth were substantially similar. A strong family relationship is also exhibited in a peculiarity of the feet pointed out by Gaudry, namely, the *proximal* phalanges were retracted and not the distal, while in the cats the *distal* phalanges are retracted and in the edentates the phalanges are not retracted at all but are flexed. In the edentates the foot is thrown upon its outer side; in the Chalicotheriidæ this was only partly the case.

Ungulate affinities of Chalicotherium. M. Filhol's view is that this genus belongs to a group which bridges the gap between the Edentates and Ungulates. When he showed me his newly discovered skeleton in 1889, I was especially struck by the perissodactyl character of the carpus and tarsus, and considered it best to leave the genus in the Perissodactyla as "an aberrant form, with nearest affinities to *Palæosyops* and genera of that line." It has also been doubtfully placed near the Perissodactyla by Flower and Lydekker.

Depéret has now advanced sufficient evidence to exclude the edentate idea entirely and shows clearly that the resemblances which *Chalicotherium* bears to the sloths are purely superficial. As shown above the adaptations of the phalanges for prehension or digging involve an entirely different set of muscles from those employed in either the Cats or the Edentates. This genus has attained a somewhat similar functional result by a different route—a case of analogy but not of homology. So with the elongation and curvature of the fore-arm, the ultimate coalescence of the ulna and the radius, the backward direction of the olecranon, the cleft ungual phalanges. All these are independent and "parallel" or "homoplastic" adaptations. *Chalicotherium* is still more positively separated from the Edentates by the numerous ungulate characters which it displays.

Depéret is very much impressed by these ungulate structures and places this genus definitely among the Perissodactyla. Let us, therefore, examine the ungulate hypothesis. Upon the affirmative side is the structure of the molar teeth; they certainly bear a distant resemblance to those of *Anoplotherium* and a more striking likeness to those of *Palæosyops* and *Titanotherium*. The reduction of the upper cutting teeth may be regarded as a secondary adaptation which does not affect the question of ungulate affinity either way. There are really several questions involved; shall we waive the structure of the terminal phalanges and call this genus an Ungulate? Shall we then direct our attention upon the teeth and carpals and tarsals and call it a Perissodactyl, or shall we follow Cope and remove it entirely to the Unguiculata? Let us sum up some of its leading characters:

CHARACTERS OF CHALICOTHERIUM.

Shared by Ungulates.	*Shared by Perissodactyla.*	*Not found in Perissodactyla.*
Radius transverse proximally, with two fossæ for humerus.	Tridactyl manus and pes.	Not mesaxonic.
Tibia with two fossæ, spine and crest.	Astragalus and all carpal and tarsal facets diplarthrous.	Main axis through fourth digit.
Calcaneum with broad sustentaculum.		Secondary unquiculate modifications of limbs and phalanges.
Diplarthry in carpus and tarsus.		Third trochanter absent.
Jaws with elevated condyle and broad angle.	Buno-selenodont molar type.	Large curved tympanic bullæ.
Molar teeth of sexitubercular origin.		Reduction of upper incisors.

This table shows that there are many characters, beside the form of the phalanges, which excludes this family from the Perissodactyla proper. The detailed comparisons of the skull which Depéret institutes with *Palæotherium* and *Palæosyops* relate to structures which are shared by all primitive Ungulates. The only structures in which there is apparently conclusive evidence of a remote relationship to this great division of the Ungulates is first in the teeth and second in the carpus and tarsus. It remains, therefore, to be seen whether these also are products of homoplasy or "parallel adaptation," or whether they really evince affinity.

Now let us turn to the broader question. Is *Chalicotherium* to be classed as an ungulate or as an unguiculate in the Linnæan sense? We should, of course, compare it first with the primitive ungulata which exhibit many unguiculate characters. We are again guided partly by the excellent figures and descriptions given by Depéret of *C. magnum* (race Rhodanicum). The skull resembles that of the Ungulata Condylarthra in many features. The occiput is very low and broad and widely overhangs the condyles. There is a well arched sagittal crest and a rather small cranium. The lower jaw has an elevated condyle and a deeply extended angle. The external auditory meatus is widely open below and there is a large mastoid pro-

cess. The maxillary bones are high. All these characters are very similar to those in the skulls of the primitive Condylarthra, such as *Periptychus*, *Phenacodus* and *Meniscotherium*. We should also mention many cranial features which we believe belong to the category of secondary adaptive modifications; among such are the following: (1) the large curved cylindrical tympanic bullæ, (2) the feeble character of the nasals, premaxillaries and anterior portion of the mandibular rami. The latter modifications are associated with the reduction of the cutting teeth. Filhol has shown that the young individuals of Sansan have a full set of incisors, while in the adult the upper incisors are rudimentary or wanting.

There are other secondary features of note. The condylar facets are prolonged forward upon the basi-occipitals. The posterior face of the centrum of the axis is directed upward; this and the preceding features point to peculiar flexibility of the neck. The centrum of the axis is long and slender, the odontoid process is round, the spine is unusually long and high.

Looking again at the limbs we observe that the radius covers the entire front face of the ulna and presents two distinct fossæ for the condyles of the humerus. The tibia closely resembles that of some of the short-limbed ungulates in its cnemial crest and two fossæ for the femur, in its spine and distal grooves for the double trochlea of the astragalus which is like that in the short-footed *Aphelops*. This likeness to the ungulates, and especially to the perissodactyls, in the form of the upper foot bones and of their articulations with the metapodials is most striking. The calcaneum has a long tuber and very broad sustentaculum. The astragalus rests widely upon the cuboid, its tibial trochlea is very similar to that in the short-footed rhinoceroses. The cuboid, navicular and cuneiforms are, however, extremely flattened and specialized. The diplarthrous character of the carpus is precisely like that of Perissodactyla, the lunar rests upon the cuneiform and the scaphoid upon the magnum, while the metapodials abut laterally against the unciform and magnum.

Upon the whole we find that primitive and secondary ungulate characters decidedly predominate in the skull, teeth and skeleton. The secondary characters, especially in the ankle and wrist joints, are parallel with those in the perissodactyls, and are not mingled with unguiculate adaptations until we reach the phalanges.

Relation to the Unguiculata. Cope was the first to advocate the more radical view that this genus represents a distinct order. He wrote: "It has little relation to the family of Perissodactyla to which it has given the name (Palæosyops). Unlike the serial manus and pes of the edentata the carpus and tarsus are here diplarthrous in structure or displaced upon each other. While the Condylarthra are ungulate with an unguiculate carpus and tarsus, this order Ancylopoda presents the antithesis of including unguiculates with an ungulate carpus and tarsus." This antithesis he assigned as the main character of the new order.[2] He still considers the form of the terminal phalanges as of fundamental importance and believes (in a letter of May 14, 1892) that *Chalicotherium* must have been derived from some primitive unguiculate.

The ancestry of Chalicotherium. Without any knowledge of the ancestors of *Chalicotherium* we thus reach a dead lock. Shall the unguiculate structure of the phalanges outweigh the ungulate structures in other parts of the skeleton? Is it possible to derive such a skull and skeleton from any unguiculate or such terminal phalanges from any ungulate? In looking about for relatives of this genus we must now entirely discard the Palæosyops group, and hunt among the lowest Eocene types. The lowest Eocene unguiculates are wholly dissimilar. The only form at all similar is the genus Meniscotherium. Meniscotherium was a little plantigrade slightly larger than Hyrax, and of very similar proportions. It is found in the beds between the Wahsatch and Puerco and was even older than Coryphodon. The teeth are of the ungulate type known as

[2]Gill's term "Chalicotheroidea" was applied to these forms, considered as a super-family, equivalent to the Camelidæ, Giraffidæ, etc., and not as a suborder. Arr. Fam. of Mamm., 1872, p. 71–77.

"buno-selenodont." The feet are in the border region between the unguiculates and ungulates. This genus also occupies an isolated position; although placed by Cope in the family Meniscotheriidæ among the Condylarthra it is not even remotely related to any of the contemporary ungulates. Its molar evolution was precocious in both jaws, far more so than in Phenacodus. I was led to the idea that this might possibly be the long sought ancestor of Chalicotherium by the structure of the molar teeth. In 1886 Wortman regarded Meniscotherium as an ancestor of the Hyracoidea. Later Schlosser recognized the striking likeness of its molars to those of Chalicotherium, and considered it with Macrauchenia as a representative of Perissodactyla which had retained a primitive foot structure.

The comparison of the entire dentition of Meniscotherium and Chalicotherium led me in 1891 to the discovery of many very significant details of resemblance. In both, the anterior portion (or cutting teeth) of the dental series is reduced and the posterior or cheek teeth are enlarged. In both, the true molars have identically the same pattern in detail in both jaws, including the absence of the third lobe upon the last lower molar, which separates Meniscotherium from all early Condylarthra and Perissodactyla. I was especially struck also by the presence of a short posterior crest formed of the hypocone and hypoconule in the upper molars, and by the reduplication of the antero-internal tubercle (metaconid) in the lower molars. At the time only the upper tarsals of Meniscotherium were known; these possess the unguiculate characters which are exhibited in Phenacodus and all early ungulates but are distinguished by a *fibular facet* upon the calcaneum. It appeared to me altogether probable that the Wahsatch form was related to the ancestors of Chalicotherium, and that the question would be decided by the discovery of its feet. This discovery was reported sooner than was expected in Marsh's recent paper upon *M.* (Hyracops) *sociale* in which the fore and hind feet are fully figured.

The feet of Meniscotherium present only one feature which definitely points to those of Chalicotherium, namely, they are

functionally tridactyl, the outer toes being much shorter than the three median toes. Marsh describes the terminal phalanges as *intermediate* between hoofs and claws, the extremities are thin, slightly expanded, and apparently covered by thin nails. In other respects the feet are very primitive and exhibit all the unguiculate features we now invariably expect to find among the primitive ungulates, namely, (1) the "centrale" and possibly (2) the "tibiale," (3) the fibular facet upon

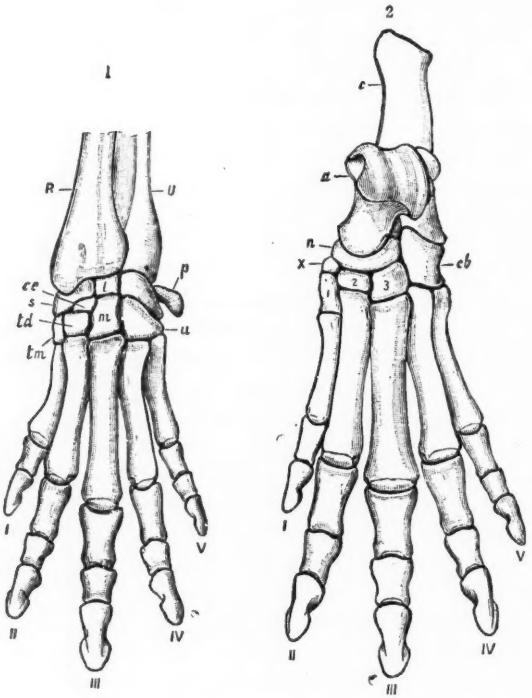


Fig 2. Fore and hind Feet of *Meniscotherium* (Hyracops) *sociale* after Marsh.

the calcaneum, (4) the "astragalar foramen," (5) the serial or undisplaced facets in both tarsus and carpus. As this was the parent ungulate type there is no insuperable difficulty in sup-

posing that the ungulate carpus and tarsus of Chalicotherium were derived from those of Meniscotherium.

The terminal phalanges present a greater obstacle; is it possible that having progressed only so far toward hoofs as to be called "intermediate," they have subsequently retrogressed into curved claw-bearing ungues? I consider this possible but not in itself probable. We must not forget the manus of the subungulate Lemurs which bears three or four terminal nails and one large claw; or the phalanges of the unguiculate Mesonyx which are cleft, but also flattened and very ungulate in appearance. The line of division between claws, nails and incipient hoofs was not very sharply drawn. Another difficulty is seen in the fact that the median toe (III) of Meniscotherium is enlarged, it is mesaxonic; while the lateral toe (IV) of Chalicotherium is enlarged.

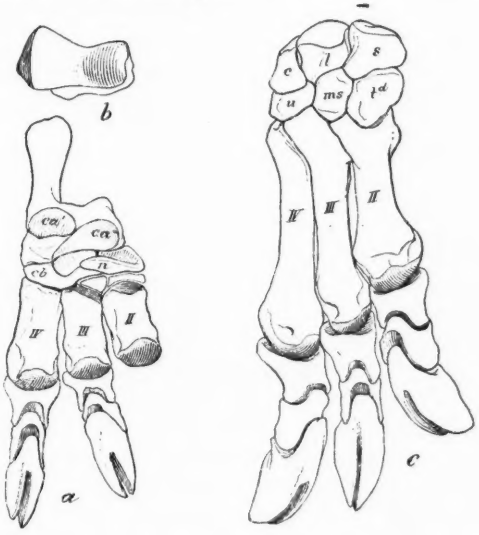


Fig 3. Fore and hind Feet of *Chalicotherium* after Gervais, (from Sansan.).

To offset these difficulties we find the striking similarities in the molar teeth already noted, and in the dental series as a whole. Meniscotherium is very exceptional in the absence of

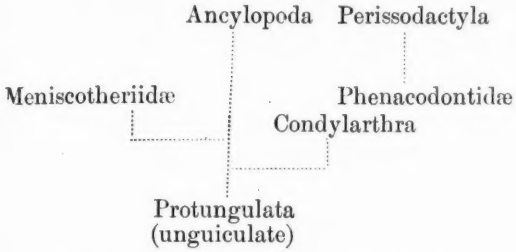
a third lobe to the last lower molar. The resemblance between the skulls of these two types is also very marked in the whole region behind the infra-orbital foramen. We see the same form of cranium, occiput, and auditory region.

I conclude, therefore, by giving a table of the resemblances and differences between the two types. Both are numerous. The question is, which are most fundamental?

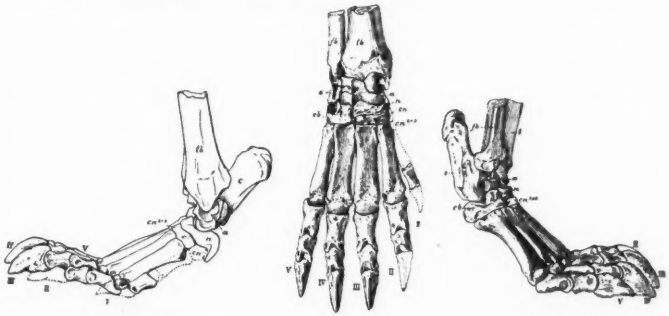
	MENISCOTHERIUM.	CHALICOTHERIUM.
1°	*Cutting teeth* somewhat reduced	Reduced or rudimentary.
	Upper molars, buno-selenodont	The same.
	A short posterior crest. Protoconule large.	The same. Protoconule reduced.
	Lower molars lopho-selenodont	The same.
	Metaconulid reduplicate. No 3rd lobe on M^3.	The same.
2°	Five *digits*. Functionally tridactyl. Mesaxonic.	Three digits. Structurally tridactyl. Not mesaxonic.
	Carpus and tarsus, serial, (unguiculate type)	Displaced (ungulate type).
3°	Centrale, tibiale, 3rd trochanter, entepicondylar foramen,	
	Fibulo-calcaneal facet	All wanting.
4°	Terminal phalanges sub-ungulate.	Unguiculate.
5°	Plantigrade.	Sub-digitigrade.

Many of these differences are such as separate higher from lower forms, especially those under 3° and 5°. We witness the loss of the primitive characters under 3° in many distinct phyla, also the modification of the characters under 2° and 5°.

I have now endeavored to clearly state the pros and cons of this question. The evidence for the original ungulate affinities of the Ancylopoda seems to me much stronger than that for its purely unguiculate origin. Supporting this view is the strong likeness of the skull and teeth of Chalicotherium to those of Meniscotherium, and finally the analogies which it presents to the perissodactyls in the modernization of the feet, wrist and ankle. My conception of its origin and zoological relations can be expressed in the following diagram.



The purpose of this paper is not, however, to express a final opinion but to suggest inquiry. While agreeing with Cope that the Ancylopoda represent a distinct division of the mammalia, we must admit that the broad zoological relations of this division are yet to be determined.



a. Internal. *b*. Anterior. *c*. External.

Fig. 4. Right hind foot of *Artionyx gaudryi*.

Postscript.—The Discovery of Artionyx.

The hind foot of *Artionyx gaudryi* was found last summer by the American Museum party, under Dr. Wortman, in the White River Miocene of South Dakota.

The discovery of this foot was one of those complete surprises which render palæontological research so fascinating. As indicated in the above article, we were daily expecting to find remains of Chalicotherium in the lower Miocene of America, but no one could have anticipated finding a type related, and yet so entirely different.

As Chalicotherium may be broadly termed an unguiculate perissodactyl, so Artionyx may be called an unguiculate artiodactyl. This, in fact, sums up the main difference between these types when we add that the terminal phalanges in the former are cleft, and in the latter are uncleft.

If this foot of *Artionyx* had the metatarsals cut off half way down, no one would hesitate to call it truly artiodactyl. The tibia, fibula, astragalus and calcaneum, the navicular with its posterior hook for the great-flexor tendon, the conjoined ecto- and mesocuneiforms, the nearly even pairs of toes on either side of the middle line—all these structures bear a marked artiodactyl stamp. The entocuneiform is missing, but there is no doubt that it supported a first digit, of which the proximal phalanx is fortunately preserved.

The distal ends of the metatarsals and the phalanges exhibit the same sudden transition to an unguiculate type which we observe in *Chalicotherium*, in fact they bear a very marked resemblance to the corresponding parts in the feet of the carnivora, until we come to the terminal phalanges, which are short, deep and laterally compressed, but not hooked or retractile. As observed above, they are not cleft.

The foot differs as widely from that of Chalicotherium as that of the pig does from that of the tapir. It is somewhat hazardous to make a deduction from the foot alone, but we have ventured to divide the Ancylopoda into two subdivisions.

ORDER.	SUB-ORDERS.
Ancylopoda. Ungulate, with unguiculate terminal phalanges.	A. *Perissonychia* (odd clawed), with perissodactyl tarsus and mesaxial reduction. Ungues cleft.
	B. *Artionychia* (even clawed), with artiodactyl tarsus and paraxial reduction. Ungues uncleft.

Subsequent discoveries may show that these are merely two families—the Chalicotheridæ and Artionychidæ. This discovery rather strengthens the idea of the relationship of Meniscotherium to the Ancylopoda—for we observe in Artionyx the fibulo-calcaneal facet of the older genus, also the depression upon the inner side of the astragalus.

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EDITORIALS.

EDITORS, E. D. COPE, AND J. S. KINGSLEY.

—Botanists are waking up to the fact that they have too long neglected to conform to the law of priority in nomenclature. The return to older names of genera, species, etc., produces temporary inconvenience, but it is in the interest of stability, which is the fundamental condition of convenience in this matter. Persons who are accustomed to use certain names find it difficult to change them, and endeavor to make exceptions to the general rule, as some leading botanists are now proposing. But the sooner a clearing up of the whole matter is made the shorter will be the discomfort, for the law of priority is fundamental and must be supported under all circumstances that fall within the scope of nomenclature.

It is evident, however, that in cases which violate other laws of nomenclature, the law of priority has no application. Such are typographic and orthographic errors; also terms which cannot be given a Latin or Greek form. Such rules are the conditions of ordinary scholarship. There is another rule which belongs to scientific scholarship which has been hitherto respected, but which a small number of American zoologists are endeavoring to set aside. This is, that no name or term is available for scientific use which has not been accompanied by a definition prior to the publication of any other name for the same thing published with a description. So self-evident is the necessity of this rule that it has been adopted without exception by all scientific societies and committees in all countries which have proposed or revised laws of nomenclature. The primary element in all exact language is the definition of terms, and to omit this condition from scientific nomenclature is to abandon science and to go into literature, if mere word-making can be dignified by such a title. When we remember what a passion this word-making becomes in some persons, it is clear that science must have some protection from it. The only way that this protection may be had is to demand a *raison d'etre* for every name that is proposed. The student then knows with what he has to deal, and the proposer places himself on record in an available form. The abuses of the neglect of this rule are self-evident, since it lays the sciences open to charlatanism and to pretence of every description, and makes scientific literature of the catalogues of the showman and the salesman.

The only body which has encouraged this abuse is the American Ornithologists Union, which in its rules straddles the question. One result of this position is that members of that body are not a unit in their opinions on this point. A concrete case is the lists of names published a half century ago by Fitzinger. In his early days this naturalist made a creditable beginning of scientific work, but he soon lapsed into a cataloguer and list-publisher. He projected comprehensive systems which have little or no correspondence with nature, and filled them out with names without definitions, many of which are not applicable to anything which can be defined. So well known has this been in Europe that this work of his has been long since relegated to the waste heap, where it should by all means be permitted to remain. But the love of change has induced a few Americans at this late day to resuscitate this rubbish. No better motive can be ascribed for this resurrection, for it is not in accordance with existing rules; it is very inconvenient; and it opens the door to continued inconvenience of the same kind. It is a blow at scientific scholarship, and a distinct encouragement to dishonest work.

It is hardly likely that the botanists will split upon this rock.

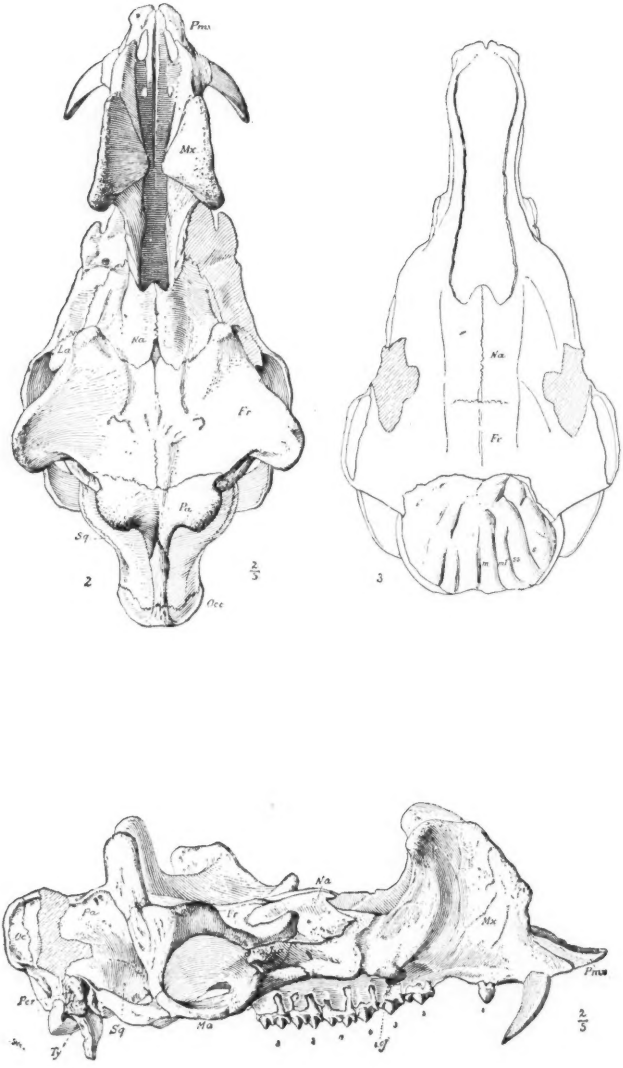
—The late meetings of the American Society of Naturalists and the allied societies of morphologists, anatomists and physiologists, held at Princeton, N. J., brought together a representative body of the most active workers in the natural sciences of the eastern part of the country. The west was ably represented by members from Cincinnati, Denison and Chicago Universities. These meetings add to the pleasures of the holidays, supplementing family reunions by professional reunions of men bound together by similarity of tastes and modes of thought. The advantages of these meetings are various, but one most obvious one is the stimulus to care and precision which results from free and friendly criticism. After living in an atmosphere of this kind, the mind more fully appreciates the contrast between the more or less careless, not to say disingenuous habits of thought that are so common, and the clear, rational, and truthful attitude of the mind which is so conspicuous in the workers in the fields of science. The welcome given by President Patton was as clear and honest as the minds of the men he faced, and it was a welcome to truth, let it come from what quarter it may.

The geologists were missed from an assembly which should include such a body of energetic workers as now constitute the Geological Society of America. In view of possible further segregation, a com-

mittee was appointed by the parent Society of Naturalists to suggest to the society some measures looking toward a combined organization, so that future cooperation might be assured. Such a combination would hold a winter meeting corresponding to the summer meeting of the American Association for the Advancement of Science, with the difference that it would consist of professional naturalists only.

—THE Smithsonian Institution has been requested by a petition signed by a large number of American naturalists and by a resolution of the American Society of Naturalists, to pay for the support of a table at the Naples Marine Biological laboratory to be occupied by American students. It would seem that such an appropriation of money is within the objects of the Institution as defined by the will of Smithson. As a school for original investigators, the Naples Laboratory has been, and doubtless will continue to be, of the greatest utility.

PLATE I.



Protoceras celer Marsh.

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——On the Skeleton of a Chimeroid Fish (Ischyodus) from the Oxford Clay of Christian Malford, Wiltshire. Ext. Ann. Mag. Nat. Hist., July, 1892.

——*Pholidophorus germanicus*, an Addition to the Fish Fauna of the Upper Lias of Whitby. Ext. Geol. Mag., Dec., 1891.

——On the Lower Devonian Fish Fauna of Campbellton, N. B. Ibid., Jan., 1892.

——The Hybodont and Cestraciont Sharks of the Cretaceous Period. Ext. Proceeds. Yorkshire Geol. and Polytechnic Soc., 1891. From the author.

WOOLMAN, L.—A Review of Artesian Horizons in Southern New Jersey. Ext. Ann. Rep. State Geol. New Jersey for 1891. From the author.

ZIEGLER, F.—Modelle zur Demonstration der Entwicklung der Zähne des Menschen. From the author.

RECENT LITERATURE.

Two Text-Books of Human Embryology.—Only a few years ago the physician who wished to know anything about the development of the human body found his whole supply of information in one or two chapters of his physiological text-book. In some respects the statements to be found there were reliable, but, at least in most American physiologies, they were strange misconceptions, as they could scarcely help being, for they were abstracts, at sixth or seventh hand of the wonderful researches of Bischoff, of Rathke and of von Baer, with never a bit of autoptic knowledge on the part of the compiler.

In the last two decades our knowledge of the embryology of man and of the other mammals has been greatly increased, so that the summary given by Balfour scarcely ten years ago is in many respects behind the times. So a new résumé in English is very acceptable. "It never rains but it pours." The same week brings to our table two works with essentially the same scope—that is the embryology of man and the mammals, with side lights on the lower vertebrates—but of greatly different treatment.

The first to be mentioned, Minot's Human Embryology,[1] is a large octavo volume, especially designed for the physician. That is, it seems admirably adapted to lead the medical student or practitioner into a clearer knowledge of the history of the human body, a knowledge of which the average physician has but the veriest smattering. Minot gives first an introduction in which he describes the uterus and outlines the stages of human development. Then the main portion of the book is divided into five parts. In the first we have an account of the history of the genital products and the theory of sex, together with a brief discussion of heredity. In Part Two the origin and meaning of the germ layers are discussed. This portion will prove more or less familiar to our readers, as several of its chapters have already been given in our pages. In the Third Part the chapters treat of the building up of the embryo, those of the Fourth of the fœtal appendages, while the Fifth Part takes up the fœtus. As an appendix given is an exceedingly condensed list of references to the authorities quoted in the text. Such a table of contents as that

[1]Human Embryology by Charles Sedgwick Minot. N. Y., William Wood & Co., 1892, pp. xxiii + 815.

given above must fail to give an adequate idea of this book, and yet it is about as much of detail as our space will allow. In general we may say that the book pleases us; that while we find a few statements here and there which we might question, we feel deeply indebted to Prof. Minot not only for the compilation of such a valuable résumé of the work of other embryologists, but for the numbers of new contributions which we find in his pages. One feature which is of especial value, and which cannot but strike the reader, is the richness of citation of the works of other students. The illustrations also are good, and while most of them are process cuts, the majority have a freshness which is very pleasing.

The other work upon our list, Prof. Mark's Translation of Hertwig's Embryology,[2] does not need very extended mention, as the original has already been noticed in this journal. Its plan is greatly different from that of Minot in that after the introductory chapters of Part One the history of development is followed for the organs of the different germ-layers: Entoderm, mesoderm, ectoderm and mesenchym. The translation is done in a very satisfactory manner, and a careful reading of a considerable portion of the translation fails to reveal many of the "awkward renderings and German idioms" to which Dr. Mark refers in the preface. One feature of the translation deserves mention. For anlage the term fundament is used. Had this translation been introduced several years ago it might hope for general acceptation, but now that anlage is being bodily carried over into English (Minot, for instance, uses it throughout), we hardly think that the translation will prevail, especially in the face of the other and not obsolete meaning of the word. The printing of the text is good, but some of the cuts of the translation (clichès from the German cuts) are muddy and lack the clearness and delicacy of the German edition.

It would have been difficult to find two men better adapted for their respective tasks than these. For ten years Dr. Minot has been accumulating the materials for his portly volume, and he has had exceptional facilities in working over the preparations of some of the European masters. Dr. Mark, on the other hand, brings to the position of translator an accurate and detailed knowledge of the subject matter, and an almost extreme care that every word in his translation shall express, so far as the genius of our language permits, exactly the

[2]Text Book of the Embryology of Man and Mammals, by Dr. Oscar Hertwig, translated from the third German edition by Edward L. Mark. London, Swan Sonnenschein; New York, Macmillan & Co. 1892, pp. xvi + 670.

idea of his author. A comparison of the two works is difficult. For the student who has already a good foundation in the broader features of general embryology, possibly Mark's Hertwig will prove the more useful, for it gives more the broader features of ontogeny without paying great attention to minor and, for him, unimportant detail. Minot's work, on the other hand, from its method of treatment, may be better adapted for the *student* of medicine, for it takes up the subject more in accordance with the ideas which he receives from the rest of his special training, and in those points which may prove of value in questions of medical jurisprudence it gives a fulness of detail which is foreign to the purpose of the other work. Yet the average practitioner will probably have little to do with either volume. All that he cares to know concerning the questions discussed, would occupy very few pages, and the 670 pages of Mark's Hertwig, and the over 800 in Minot's volume, will, we fear, scare away the very men who most need the information they contain. Yet it is difficult to see how the matter could be much more condensed. The fault is not, in either case, with the author, but rather with the extent of our knowledge. This, however, will prove no drawback for the student of morphology, and, we doubt not, these will be two of the most consulted books in his library, for they are the two most important additions in our language to the literature of biology for the year 1892.

To conclude, we would say that both books are valuable, and should be owned by all morphologists. Minot's volume is possibly the better adapted from its arrangement for the physician, and the greatest objection which we can see to its use by medical men is its size.

Geological Survey of Texas, 1891.[3]—This volume constitutes the Third Annual Report of the Geological Survey of Texas. It consists of the usual introductory statements of the State Geologist, E. T. Dumble, followed by the several reports of his assistants. The accompanying papers are reports on the geology and paleontology of important regions by specialists in those departments. Mr. Kennedy contributes the result of investigations which carried him across the post-cretaceous deposits, from Terrell, in Kaufman County, in a southeasterly direction to the mouth of the Sabine River. Mr. Cummins gives a detailed report on the geology of the Llaño Estacado. He traced the Carboniferous formation to its farthest outcrop in Central Texas, determined the northern extension of the Cretaceous along the

[3]Third Annual Report of the Geological Survey of Texas, 1891. E. T. Dumble, State Geologist, Austin, 1892.

eastern escarpment of the Staked Plains, and determined the extent of the Dockum and Blanco Canyon Beds and their relation to the underlying strata. The Stratigraphy of the Triassic formation in northwest Texas was assigned to N. F. Drake, who embodies his observations in a short paper of twenty-one pages. Mr. Steernwitz is still at work on the Trans-Pecos region. In his paper he states that rocks of Carboniferous age have been traced over a large area of this region, gives the age and relations of certain conglomerates, and the stratigraphic relationship between the schists and the red grit. Prof. E. D. Cope, who had in charge the fossil vertebrata, reports on collections from the Fayette formations, the Blanco Canyon bed, and the Triassic or Dockum beds. Dr. Sterki furnishes notes on shells found in a dry salt lake near Eddy, New Mexico.

The illustrations are numerous and compare favorably with those of previous publications of the survey.

Mineral Resources of the United States, 1889 and 1890.[4]— This volume is the seventh of the series of Mineral Resources of the United States, and carries the statistical data to Dec. 31, 1890. An idea of the amount and value of the various useful mineral products is given in a brief summary which forms the opening chapter. The remaining 530 pages comprise carefully prepared statistical papers containing much valuable information.

According to the report the year 1890 was a period of unexampled activity in mining, particularly so in iron, silver, copper, coal and petroleum. The total value of the product is put at $656,604,698, an increase far beyond any previous year.

In addition to its individual index, this volume contains the general index to the entire series from 1882 to 1890 inclusive.

[4]Mineral Resources of the United States, 1889 and 1890. David T. Day, Chief of the Division of Mining Statistics and Technology, Washington, 1892.

General Notes.

GEOLOGY AND PALEONTOLOGY.

Paleozoic Formations of Southern Minnesota.—A systematic account of the Paleozoic formations of southeastern Minnesota, by C. W. Hall and F. W. Sardeson, is given in the Bulletin of the Geological Society of America for 1892. The rocks described occupy an area some 13,200 square miles in extent. They stretch eastward from a straight line between Mankato and Hinckley to the State of Wisconsin, and from Chengwatona southward to Iowa. These periods of geologic time are represented by three formations: Upper Cambrian, Ordovician, and Devonian. These Paleozoic rocks are underlain by the Archean and Algonkian, and lie beneath patches of Cretaceous and a covering of quaternary débris save in the extreme southeastern corner included in Chamberlin's "driftless area."

The Upper Cambrian is represented in this region by the Potsdam sandstone and the Magnesian series; the Ordovician by the St. Peter, the Trenton, and the Cincinnati beds. The Devonian is present in so thin a layer in which so few fossils occur that it cannot be assigned to any division of that group, but is supposed to belong near the middle.

The writers give the following summary of thickness and leading lithological characters based chiefly upon their own measurements and determinations:

					Feet.
Devonian.	Not subdivided.		Limestone and shale		10–15
Ordovician	Cincinnati.	Wykoff.	Limestone	20	70
		Maquoketa.	Shale and limestone	20	
	Trenton	Galena.	Maclurea limestone	50	120
			Lingulasina limestone	20	
			Camarella shaly limestone	30	
			Orthisina calcareous shale	20	
		Trenton.	Zygospira shale	8	95
			Fucoid shale	20	
			Stictopora shale	30	
			Stictoporella limestone and shale	10	
			Blue limestone	12	
			Buff limestone	15	
	Saint Peter, not subdivided, sandstone				75–164
	Upper Shakopie dolomite				10–65
	Elevator B (Richmond) sandstone				20
Upper Cambrian.	Magnesian, Lower Shakopie dolomite				75–175
	Jordan sandstone				75–200
	Saint Lawrence, dolomites and shales				30–213
	Potsdam, not subdivided, sandstones and shales				0–1,300
	Total thickness of Paleozoic strata in Minnesota.....				560–2,437

The Genus Hybodus.—According to Mr. A. S. Woodward, the genus Hybodus, which was determined solely from the evidence of the teeth and associated ribbed dorsal fin-spines, is now definitely determined by the other essential regions revealed by new specimens. The fossils in question comprise numerous skulls and two portions of the trunk of the typical *Hybodus basanus* from the Wealden of the Sussex coast.

The characters which afford information are (1) the presence of hooked cephalic spines, and (2) the occurrence of a vacant space between the neural and hæmal arches of the endoskeleton, which must have been occupied by a persistent notochord. Mr. Woodward is inclined to think that the presence or absence of cephalic spines will eventually prove to be a sexual character.—Proceeds. Yorkshire Geol. and Polytechnic Soc., Vol. xii, 1891.

On Some Dicynodont and Other Reptilian Remains from the Elgin Sandstone.—At the Aberdeen meeting of British Association in 1835, Dr. Traquair called attention to the skull of a *Dicynodont* which had been discovered in the Elgin sandstone of Cutlies Hillock (= New Spynie). Since that time several other specimens have been obtained from the same place, some of which are the property of the Elgin Museum, while others belong to the Geological Survey of the United Kingdom. These specimens are now being worked out by Mr. E. T. Newton, and the following is a preliminary note on the interesting results which have been obtained.

All the reptile remains obtained from Cutlies' Hillock are in the condition of hollow casts, the bones themselves having been dissolved away; this, it will be remembered, was the case with some of the examples of *Stagonolepis* from the Elgin sandstone, described by Prof. Huxley, and the method of taking casts from the hollow cavities which was adopted in that case, has been found of great advantage in the present instance. The blocks when brought from the quarry were more or less split open, exposing portions of the specimens. In some cases these cavities were traced out and developed with the chisel, while in others they were further split open, thus allowing casts to be taken. In many cases these casts had to be made in several parts and afterwards fitted together. The time and labor involved in this task have been repaid by the restoration of the skulls and parts of skeletons of several *Dicynodonts*, and one or two other equally remarkable forms of reptiles.

In most of these specimens, including that noticed by Dr. Traquair, the skulls are similar in form, although differing in minor details, and have a general resemblance to the South African *Dicynodon* and *Oudenodon*, some of them having small tusks in the maxillary bones. With most of these skulls parts of the skeleton have been found. Two or three show the position of the vertebral column and ribs, but up to the present no definite centra have been traced; besides this there is evidence of scapula, clavicle, humerus, radius, and ulna, the humerus having the characteristic anomodont expansion of the two extremities. In two specimens the ilia are preserved. These forms appear to be distinct from *Dicynodon*, and probably represent at least two or three species.

Another skull presents most of the characters of *Lystrosaurus*, but has a short muzzle and no teeth. The last, and by far the most remarkable skull of this series, is about six inches in length, and has the outer surface completely covered in by bony plates, the nostrils, eyes, and pineal fossa being the only apertures. The chief feature of this skull is the extreme development of horns upon the face and cheeks, there being about thirty of these formidable defences varying from about a fourth of an inch to nearly three inches in length, besides some smaller bones. The dentition is pleurodont, and resembles very closely that of the living Iguana; the palate is lacertilian, but with the pterygoids united in front of the pterygoid vacuity. This skull reminds one very strongly of the living *Moloch* and *Phrynosoma*, but it probably finds its nearest ally in the *Pareiasaurus* from the South African Karoo bed. The detailed description of these specimens is nearly completed and will, it is hoped, be shortly published.—Geol. Mag., Nov., 1892.

Cenozoic Insects.—In discussing the Rhynchophora of North America, Mr. S. H. Scudder refers to the variety and abundance of insect life during the early Cenozoic period as follows:

"In the earlier Tertiaries we not only possess in profusion representatives of every one of the orders of insects, but every dominating family type which exists to-day has been recognized in the rocks; even many of the families which have but a meager representation to-day have also been discovered, and though many extinct genera have been recognized, no higher groups, with a single exception or two, have been founded upon extinct forms. This is one of the most striking facts which confronts the student of fossil insects. It is the more striking from the delicacy, the tenuity, and miniatures of many

of the forms which are here concerned; and the statement can be enforced by the further fact that the parasitic groups—those which are entomophagous—are represented, as well as many of those which in the present time show peculiar modes of life; thus we have representatives of such microscopic parasitic insects as Myrmar, strepsipterons have been discovered, the viviparity of the ancient Aphides has been shown probable, the special sexual forms of ants and white ants were as clearly marked as to-day, and the triungulin larva of Meloe has been found enclosed in amber, showing that the phenomenon of hypermetamorphism had already been developed.—Proceeds. Boston Soc. Nat. Hist., Jan., 1892.

Uplifts in the Sierras of California.—A paper of Mills in the Bull. G. S. A., Vol. 3, contains the following account of the orographic movements from which result northern half of the Sierra Nevada range.

Along the axes of the greatest uplifting of the present range a pre-Mesozoic range arose carrying up both crystalline and metamorphosed sedimentary rocks, which partially disappeared through erosion and subsidence; then a mesozoic range arose and its strata became uptilted, and it in turn was reduced by erosion and subsidence to very small proportions, and then in Tertiary and Quaternary time has arisen the present range, which is now undergoing its erosion."

A New Pliocene Ruminant.—The right mandible of a large animal found in the lowest Pliocene formation in the vicinity of Oran has been referred to the order of Artiodactyla by M. Pomel under the name *Libytherium maurusium*. In dimensions it rivals Helladotherium, with which it has some affinities, but from which it differs unmistakably. The fossil measures 30 centimetres from the posterior border of the last molar to the posterior part of symphysis.—Revue Scientifique, July, 1892.

A Remarkable Artiodactyle from the White River Epoch.—In a late number of the Bulletin of the American Museum of Natural History, Drs. Osborn and Wortman describe a species of Artiodactyle which differs much from any form previously known. A considerable part of the skeleton was obtained, together with crania of both male and female. The superior premolars (except the last) are simple, thus excluding the genus from the Boöidea, and the cuboid and navicular bones are distinct, a character which separates it from

the Tragulidæ. The cervical vertebræ are undescribed, but the characters in general refer it to the Oreodontidæ rather than to any group of the camel series. The metapodial bones are distinct, and there are four in front and two posteriorly. Both sexes have a pair of low horn-cores or tuberosities on the parietal bones, but the male has other tuberosities and processes as follows: The superciliary borders are produced posteriorly into a prominent lobe, and a low tuberosity rises from the frontal at its anterior border, just in front of the orbit. Each maxillary develops an anteriorly projecting process above the last premolar tooth, and then rises into a huge elevated compressed plate with thickened apex at the side of the narrow nasal fissure. The latter opens far posteriorly, as the nasal bones are very short and wide. The molar teeth are Oreodontoid, and the superior canines are worn posteriorly, showing that there was a large inferior first premolar as in Oreodon. The canine has also the triangular section seen in that family. The inferior canine is recumbent, and resembles an incisor. No superior incisors.

The absence of superior incisors is a character which is uncommon in the Oreodontidæ, but is found in the genus Merycopater, and probably in Pithecistes. The discovery of a horned member of the group is interesting. The female of the species was first described by Marsh under the name of *Protoceras celer*. It is probable, however, that it is nearly allied to, if not actually pertaining to the genus Stibarus Cope, described in 1873. The latter was founded on a fragment of lower jaw with premolar teeth, a part which has not been found in the species described by Drs. Osborn and Wortman. The latter was found by Dr. Wortman in the upper White River beds; the *Stibarus obtusilobus* is a smaller species, and comes from the lower beds of the same series. I give figures of parts of the skeleton from clichés kindly furnished by Dr. Osborn (Plates I and II).—E. D. Cope.

The White Clays of the Ohio Region.—In southeastern Indiana and southwestern Ohio occur a series of clays overlying the glacial beds and differing from them in color and structure. There are similar clay deposits in southern Ohio outside the glacial boundary. Mr. Frank Leverett, in a paper published in the Amer. Geol., July, 1892, cites evidence to show that these deposits are synchronous, that they have a common origin, that that origin is independent of both ice-dams and organic agencies, but is best explained by a fluvio-lacustrine hypothesis. Furthermore, they furnish important evidence concerning the sequence of events in this region during the glacial period.

Geological News, General.—Mr. R. S. Tarr has published a paper in the Am. Geol., July, 1892, calling attention to the relation of secular decay of rocks to the formation of sediments. The essay is in the main a summary of the present knowledge of secular disintegration.——The rocks of the Guadalupe Mountains are referred by R. S. Tarr to the Upper Coal Measures instead of the Permian as determined by Shumard. Bull. No. 3, Geol. Surv. Texas.——A Geological and Agricultural Survey of the State of Louisiana has been undertaken in the interest of agriculture, the first publication of which has just been issued. It consists of a preliminary report on the northern part of the State, by Dr. Otto Lerch, covering the Topography, General Geology, Water Supply, Distribution of Soils and Useful Minerals.——M. Adolph Carnot states that the relative age of fossil bones can be ascertained by estimating the amount of fluoride of calcium entering into their percentage composition. His method was applied recently to determine whether a human tibia was contemporaneous with the bones of animals with which it was associated. The chemical analysis proved that the tibia contained only the same percentage of fluoride as a recent human bone, while the associated animal remains yielded seven to nine times as much fluoride as their recent analogues. Hence the tibia in question belongs to a later period than the other fossils with which it was found, a result in which M. Riviére acquiesces on other grounds.—Comptes-Rendus, Vol. cxv, pp. 337–339.

Archean.—Dr. Charles Barrois announces the discovery of Radiolaria in the Archean rocks of Brittany. The fossils occur in a fine siliceous matrix (phtanite) associated with fragments of graphite, in the neighborhood of Lamballe, Côtes-du-Nord. M. Cayeux, to whom the fossils were submitted, regards them as simple Radiolaria, of the family Monosphæridæ.—Natural Science, Oct., 1892.

Paleozoic.—According to Dr. Rüst, Radiolarian fossils are abundant in Paleozoic rocks, and nearly all of the Paleozoic Radiolaria can be referred to the genera recognized by Haeckel in the seas of to-day. —Palæontographica, Vol. xxxviii, pp. 107–200.

Three new species of fish—*Protodus jexii, Diplodus problematicus,* and *Acanthodes semistriatus*—have been added to the list of Lower Devonian Fish-fauna by Mr. A. S. Woodward. The fossils were collected by Mr. Jex at Campbellton, New Brunswick, and are now in the British Museum.—Geol. Mag., Jan., 1892.

Mr. J. C. White reports a small collection of fossil plants from the Wichita beds of Texas. They are essentially the same with the flora from southwestern Pennsylvania described by Prof. Fontaine. This makes an equivalency probable between the uppermost beds of the Carboniferous system in West Virginia, southwestern Pennsylvania and southern Ohio (the Dunkard Creek series), and those of the Wichita beds of Texas—Bull. Geol. Soc. Am., Vol. iii.

Mesozoic.—A Termite, discovered in the English Lias by Mr. Montagu Brown, exhibits even the patches of pigment on the wings. It is described by Dr. Henry Woodward in the May number of the Geol. Mag. under the name *Palæotermes ellisii.*——Mr. A. S. Woodward reports *Pholidophorus germanicus* from the Upper Lias of Whitby, Yorkshire. This Lepidosteoid fish was observed by Quensted in the Lias of Würtemburg and named in 1858.—Geol. Mag., Dec., 1891.——A mammalian tooth discovered by Mr. Charles Dawson has been given the provisional name *Plagiaulax dawsonii* by Mr. A. S. Woodward, who describes and figures it in the Proceeds. London Zool. Soc., Nov., 1891. This fossil is the first evidence of a European Cretaceous mammal.——A fine specimen of Belonostomus from the Rolling Downs formation (Cretaceous) of Central Queensland is described and figured by Mr. Etheridge in the Trans. Roy. Soc. Victoria, 1891, under the name *Belonostomus sweetii.* The specimen is supplemented by four other fragments so that all the more important features in the skeleton of the fish are made known.

Cenozoic.—A proof of the identity of the diatomaceous beds of New Jersey, Delaware and the outcrops on the western shore of Chesapeake Bay is afforded by the presence of a single specific form of diatom, Heliopelta, which occurs at the base only of this bed, and has not been found elsewhere in the world, either fossil or recent.—Ann. Rep. State Geol. New Jersey, 1891.——Mr. Harlé reports the finding of the right mandible of a monkey in a cave in the stone quarry of Montsaunés. The fossil in question is that of a Macaque and as it appears to Mr. Harlé to be a distinct species, he has given the name *Macacus tolosanus.*—Comptes-rendus, fev. 1892.——A list of Birds from the so-called Post-Pliocene drifts of Queensland, by Mr. De Vis, is an interesting contribution to avian literature. The list comprises twenty-eight species referred to twenty-four genera. The whole of the twenty-eight species and seven or perhaps eight of the genera are extinct. This change is very much the same as that observed in the case of the marsupials.—Proceeds Linn. Soc. N. S. W., Vol. vi.

ZOOLOGY.

The Cercaria Stage of Amphistomum.—Dr. Albert Lang has completed[1] the life-history of *Amphistomum subclavatum*. The adult lives in the frog, the young in the small *Planorbis contortus* of Germany. He finds that the young become encysted upon the skin of the frog, and as this is eaten at the time of molting the young obtain access to the alimentary canal in that way. Lang also describes some points in the anatomy of the Cercaria. Especially interesting is the description of the excretory apparatus which cannot well be reproduced without a figure.

Fecundation of the Eggs of Clinus argentatus.—M. Frederic Gintel gives the following account of the habits of a fish known as *Clinus argentatus* during the deposition of the eggs and their fecundation by the male:

"The extrusion of the eggs occupies about half an hour, and they are deposited among the branches of a clump of seaweed, after which the female goes away and the male comes in his turn to the algæ to fertilize the eggs, of which he then becomes the guardian until they are hatched, driving away all the males and females that come near to the nest. If the latter, however, are gravid, he invites them to lay their eggs near those which he is already guarding. M. Gintel has seen a male fecundate successively, and to care for seven separate depositions by as many different females, at intervals of several days. —Revue Scientifique, Août, 1892.

Preliminary Descriptions of New Fishes from the Northwest.—In the November number of THE NATURALIST we described a few of the new species collected in western Canada. We shall here describe in a brief way the remainder of the new species. Full descriptions as well as a general report on the collections and a comparison between the fish faunas of the Red River of the North, the Saskatchewan, the Missouri, the Columbia, and the Fraser River will appear later, the MS. of the entire report being ready for the press.

1. *Pantosteus columbianus* E. & E.

Three specimens, 92–100 mm. Boise River, Caldwell, Oregon. Related to *P. generosus*, the eye larger, the caudal longer. Head

[1]Berichte Naturf. Gesell. Freiburg vi, 81, 1892.

$4\frac{2}{5}$–$4\frac{3}{5}$; D. II, $11\frac{1}{2}$ or $12\frac{1}{2}$; A I, $8\frac{1}{2}$; scales, 16–19–80–100–15; eye, $1\frac{1}{2}$–2 in. snout, $1\frac{1}{5}$ to $1\frac{3}{5}$ in interorbital, $3\frac{3}{4}$ to little more than 4 in head. All the fins pointed, the caudal lobes considerably longer than the head. Light brown, with indistinct clouds of darker.

2. *Notropis albeolus* E. & E.

One specimen 73 mm. long. Medicine Hat, Assiniboia.

Related to *N. maculatus* and *N. heterodon*. D. $9\frac{1}{2}$; A. $8\frac{1}{2}$; scales, 4–35–4; 15 scales before dorsal; teeth 4–4, 1, 2.

More slender than *heterolepis;* fins all small; origin of dorsal over ventral, equidistant from base of middle caudal rays and nares; scales closely imbricated, the exposed edges little higher than long. Lateral line decurved, the tubes developed on fewer than ten scales; ventral surface entirely white; a plumbeous lateral band overlaid with silvery; a dark vertebral line from occiput to caudal; sides with a few dark specks, dorsal surface more densely specked, the margins of the scales darker.

3. *Notropis heterolepis* E. & E.

One specimen 35 mm. long. Fort Quappelle.

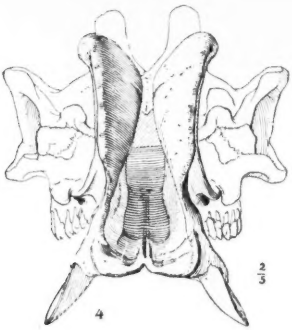
Related to *N. heterodon* and *N. anogenus*. D. $9\frac{1}{2}$; A. $9\frac{1}{2}$; scales 5–35–4; 15 scales in front of the dorsal; teeth 4–4; dorsal inserted equidistant between base of upper caudal rays and anterior margin of eye, behind the last ray of the dorsal; scales loosely imbricated, almost imbedded in front of the dorsal; scales along the median line with a deep notch near the middle of the posterior margin; the line nearly straight; a few black specks along the base of the anal, a dark line from anal to caudal; a dark band from tip of snout along the sides to the caudal; a conspicuous black curved line at the base of each scale of the lateral line; all the scales above the lateral band dotted with black; a narrow vertebral line from occiput to dorsal, a broad dusky band on the back between the dorsal and caudal, between this and the lateral band a lighter band; scales of back with dark markings; series of minute black dots along each ray of the dorsal, anal and anterior portion of pectoral; dorsal and caudal quite dark.

4. *Notropis reticulatus* E. & E.

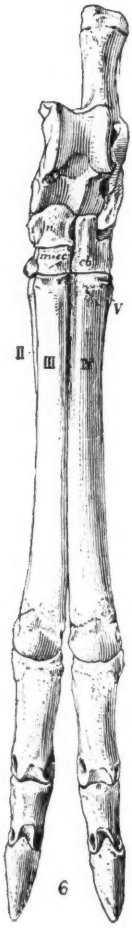
Twenty-four specimens from Fort Quappelle. Thirteen specimens, the largest 76 mm. from Brandon.

Related to *N. spectrunculus, fretensis, nitidus* and *topeka*. It approaches nearest to *N. fretensis* and *topeka*. From the former it differs chiefly in the larger scales in front of the dorsal and from the latter in the naked breast.

PLATE II.



4 $\frac{2}{3}$



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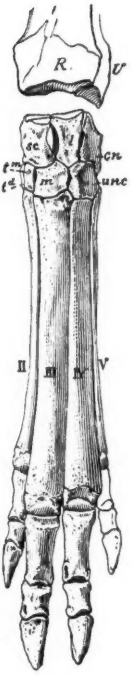


5

Protoceras celer **Marsh.**

Head 4, depth 4–4½; D. 9½ or 10½ (I or II, 8½); A. 9½ (II, 7½); scales 4 or 5–34–3 or 4; scales in front of dorsal, 12 or 14; teeth 4–4, hooked, with evident grinding surface; head pointed, broad above, and slightly convex; snout decurved, pointed, the lower jaw included; mouth oblique, the premaxillary on a level with the lower margin of the pupil or somewhat lower; maxillary reaching front of orbit; eye large, considerably longer than snout, 3 in head, greater than interorbital; origin of dorsal over ventrals, equidistant from tip of snout and base of upper caudal rays; longest ray scarcely extending beyond tip of last when depressed; anal low, the longest ray not extending beyond tip of last when fin is depressed, equal to snout and eye; ventrals reaching vent, slightly longer than the highest anal ray; pectorals little longer than head, less opercle; scales closely imbricated, the exposed edges considerably deeper than long in the largest specimens; lateral line decurved, complete; breast naked.

Dark streak from anal to caudal, lower parts otherwise plain; a dark vertebral line, a plumbeous band along the side: a faint spot at the base of the caudal about as large as the pupil; a series of spots along each side of the lateral line; upper parts of sides and the back profusely spotted, the edges of the scales are black, giving the whole part a reticulated appearance. The specimens from Quappelle are darker than those from Brandon.

5. *Notropis scopiferus* E. & E.

Many specimens from Winnipeg, Brandon, Fort Quappelle, Medicine Hat.

This species is evidently closely related to *N. luciodus*, from which it differs in having a conspicuous jet black spot about as large as the pupil at the base of the caudal fin.

Head 4–4½; depth 4½; D. 9½; A. 10½ (II, 8½); scales 6-36 to 42-4; 14–18 scales in front of the dorsal; teeth 2, 4–4, 2 grinding surface very narrow, on two teeth only; head heavy, compressed, flat above; snout blunt, much decurved; mouth small, little oblique; maxillary extending to eye; eye, 3 in head, little less than interorbital; lateral line complete, evenly and gently decurved to above origin of anal; a conspicuous black spot at the base of the middle caudal rays; a silvery lateral band, its dorsal margin distinct, color otherwise variable.

6. *Agosia falcata* E. & E.

Many specimens. Boise River, Caldwell, Idaho.

Scales larger and fins much longer than in *A. nubila*.

Head 3¾; depth 4½–5¼; D. 11½; A. 9½; scales 53–60, about ten above the lateral line; dorsal usually inserted directly over the origin

of the ventrals, the fin large, its anterior rays prolonged; origin of dorsal equidistant from base of middle caudal rays and nares; caudal deeply forked, the lobes acute, $3\frac{2}{5}$ to $3\frac{4}{5}$ in the length; anal rays $4\frac{1}{3}$–$4\frac{3}{4}$ in the length; ventrals always more posterior in position than in *nubila*, their tips extending to or past middle of base of anal; pectorals not reaching ventrals.

A dark band forward from eye; dark lateral band scarcely evident; silvery below; sides and back with numerous irregular, well-defined dark blotches; anal and sometimes ventrals with a dusky spot near base in front; dorsal and caudal faintly mottled; crimson spots on mandible, axil of ventrals and along base of anal.

7. *Agosia shuswap* E. & E.

Four specimens. Shuswap Lake, near mouth of Eagle River.

These specimens differ from *A. falcata* in a few characters; intergradations may be found, but none exist in our specimens.

Dorsal equidistant from base of middle caudal rays and posterior half of eye, inserted directly over origin of ventrals; lateral band well marked, otherwise as in *A. falcata*.

C. H. AND R. S. EIGENMANN.

The Larynx of Batrachia.—Dr. H. H. Wilder states[2] that Amphibia typically possess two pairs of laryngeal cartilages, an anterior pair of arytenoids, while the posterior, containing tracheal rings as well as the future cricoids, are best called tracheal elements. In Proteus and Necturus but one pair is present, while in many Anura the tracheal elements fuse in the median line, forming a sort of cricoid. Wilder suggests, arguing from position, innervation, and musculature, that the arytenoids are the fifth branchial arches and are further homologous with the so-called inferior pharyngeal bones of Teleosts. The tracheal elements, on the other hand, are new formations.

The Kidney of Amphiuma.—Dr. H. H. Field has studied the kidney anlage in young Amphiuma and finds[3] that here as in the Cæcilians as described by Semon, there is a true metamerism. In his material (which has already served for other studies published in these pages[4]) the kidney reached back to the cloacal region, and it was possible to follow the different stages of formation of the canals. In the caudal region in the middle of each somite there was a wide, sharply

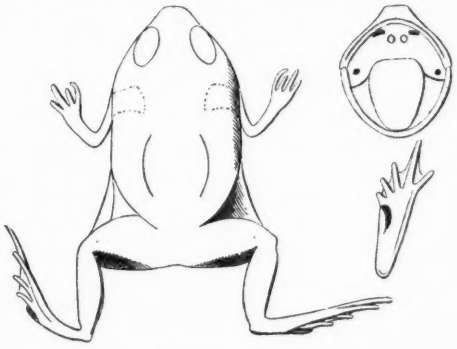
[2]Anat. Anzeiger, vii, 570, 1892.

[3]Verh. Deutschen Zool. Gesellschaft, 1892, p. 113.

[4]Hay, AM. NAT., xxii, p. 315, 1888; Kingsley l. c. xxvi, p. 671, 1892.

bent tube which communicated on the one hand by a nephrostome with the body cavity, and on the other empties into the segmental duct. Immediately above the nephrostome was the malpighian body. Going forward the looping of the duct becomes more extensive, and extends from wall to wall of the somite, but no anastomoses occur and the nephrostome is always in the middle of the somite. The ontogeny of this organ will doubtless prove of extreme interest, and this point goes to support Cope's thesis of the relationships of Amphiuma to the Gymnophiona.

On a New Spade-Foot from Texas.—*Spea laticeps* sp. nov. —Frontoparietal bones without fontanelle, smooth. Form of head and body short and wide. Width of head at tympana entering length of head and body two and one-quarter times. Front wide and perfectly flat, its width entering the length of the tibia two and one-quarter times, and considerably exceeding the width of an eyelid. Muzzle



Spea laticeps Cope, nat. size.

projecting little beyond lip; nostrils nearly terminal; canthus rostralis not marked; tympanum concealed; vomerine fascicles small, posterior to a line connecting the choanæ. The latter exceed in diameter the well-developed ostia pharyngea of the eustachian tubes.

The heel of the extended hind leg reaches the position of the tympanum. Its digits are half-webbed, three and one-half phalanges of the fourth digit remaining free. On closing the fingers the second a little exceeds the third in length, and the third exceeds the fifth. The integument of the superior and lateral surfaces extends to or beyond the middle of the femur. It is obscurely tubercular, and the inferior surfaces are smooth. There are no distinct glandular aggregations of

crypts. The length of the head and body is 38.5 mm.; length of head (axial), including tympanic region, 14.5 mm.; width of interorbital space, 6 mm.; of head at tympana, 18 mm.; length of fore leg from axilla, 19 mm.; length of hind leg from urostyle, 41 mm.; length of tibia, 12.5 mm.; of foot, 20 mm.

Color of superior surfaces brown, varied with large obscure spots of dark brown.

There are no pale longitudinal stripes, but the borders of the sacral region are pale and contract posteriorly, enclosing a narrow dark band above the urostyle. This pale outline is bordered externally by brown, and from this dark spots or bands extend transversely. There is a dark spot on the canthus rostralis; one on each side of the end of the muzzle, one below the eye, and one posterior to the eye. Gular region light yellow, rest of lower surface dirty white. Sheaths of hallux black bordered.

The single specimen of this species before me is smaller than the average *S. hammondii* proper, and is equal to the larger individuals of the *S. h. bombifrons*. Its color and the position of its vomerine teeth are more like those of the *Scaphiopus couchii*, but the proportions and the perfectly smooth cranial bones with free integument, distinguish it readily.

This interesting species approximates more closely the genus Scaphiopus than the known species of Spea. It was found by Mr. Wm. L. Black, of Prof. W. F. Cummins' party of the geological survey of Texas, on the journey between Seymour, in northwest Texas south of the Red River, and Austin. Mr. Black obtained on the same expedition three species of Bufo, viz., *B. compactilis*, *B. debilis* and *B. punctatus*. The range of the last named is thus much extended eastward. A specimen of the snake *Tropidoclonium lineatum* was also obtained, which extends its range much westward, Dallas having been the previous limit in this direction.—E. D. Cope.

The Pedal Skeleton of the Dorking Fowl.—Mr. G. B. Howes has been studying the pedal skeleton of two Dorking chicks, reaching conclusions somewhat different from those of Mr. Cowper, who has recently published studies of the adult structure. As a result of his anatomical researches Mr. Howes advances the theory that the two innermost digits of the Dorking fowl's pes are the product of the cleavage of the hallux, and adduces the recent discovery by Kükenthal of an undoubted occasional splitting of the Cetacean pollex as a support of this argument. Mr. Howes states also that the types of the

hexadactyle limb met with in the Amniota, as well as the pentadactyle pes of the Dorking fowl, is a monstrous formation, and that arguments deduced from their study in support of hexa- and heptadactyle limbs are premature. The author calls attention to the fact that inasmuch as no observed amphibian either living or extinct is known to have borne more than two phalanges upon its second digit, neither the sauropsidian nor the mammalian types can be derived from that of the Amphibia except by a process of intercalation such as there is no evidence to support. As involving the Mammalia, the force of the argument against a belief in the amphibian origin of the class it is second only to that of the discovery of the mammalian condition of the limbs in the Theromorous Reptiles.—Jour. Anat. and Phys., Vol. xxvi.

EMBRYOLOGY.[1]

Experimental Embryology.—Under this title may be included two most interesting recent contributions to our knowledge of the significance of the cleavage phenomena in animal eggs. Both deal with the cleavage phenomena of eggs influenced by experimental interference; the one in the case of a Vertebrate, the other in an Echinoderm.

Prof. E. B. Wilson,[2] of Columbia College, finds that the cleavage cells of an Amphioxus egg when shaken apart are yet capable of developing into gastrulas or even into complete larvæ of perfectly normal structure. Yet the *size* of the gastrulæ or larvæ is determined by the size of the cleaving cell; thus if one of the first two cells is taken the resulting gastrula is half the normal size, if one of the first four is taken, the gastrula is one-fourth the normal bulk. Gastrulas of one-eighth the normal size occurred but were not products of isolated cells in the eight-cell stage; in fact, the experiments go to show that one of these first eight cells is incapable of forming a gastrula. There is thus an early limit set upon the potentialities of the cleavage cells. This, moreover, seems to be a qualitative and not a quantitative limit. The homogeneous, undifferentiated character of the cells is lost at the eight-celled stage.

When the cells are incompletely separated, double, triple, and even quadruple embryos are formed.

Comparing the development of the isolated cells of Amphioxus with what is known of similar phenomena in other Vertebrates as known from the work of Roux upon the frog, or with the facts established for Echinoderms by Dreisch and others, we find an important and fundamental difference in the time at which individuation and symmetry become apparent. While in the Echinoderm the partial development proceeds at first as if all the cells were present, and only later what may, improperly, be called a process of *regeneration*, forms that which was lacking to the completion of a normal symmetrical embryo, in Amphioxus, as the author shows by diagrams giving more accurate observations than had hitherto been made upon the exact mode of cleaving,—"the isolated

[1]This department is edited by Dr. E. A. Andrews, Johns Hopkins University.

[2]On Multiple and Partial Development in Amphioxus. Anat. Anz., 1892, Nos. 23-24.

blastomere develops as a unit, not as a half-unit; and the cells to which it gives rise cannot be individually identified with those of a normal embryo-half. The development is transformed from the beginning."

The second paper, by Hans Dreisch, of Zürich,[3] contains many important facts not presented in the preliminary article noticed in the December NATURALIST.

When the eggs of certain sea-urchins are exposed to high temperatures an acceleration in the rapidity of cleavage processes is not the only result—but at a temperature of 31° C. certain marked changes both in the size and position of cells, the entire absence of micromeres and other such fundamental effects are produced. Nevertheless eggs that cleave in these abnormal ways may develop into perfectly normal larval forms, plutei. Long continued exposure to such temperatures acts like the mechanical force applied in shaking eggs in a test-tube and results in the separation of cleaving eggs into two, rarely more than two portions, each of which may then develop by itself. As some of these portions form normal larvæ, high temperature may be one of the factors concerned in the formation of multiple embryos.

Returning to the cleavage of cells separated by shaking echinoderm eggs, a series of figures are given to illustrate the fact that the isolated cells continue to cleave, for a time, as if still in combination with their fellow cells. Thus three cells taken from a four-celled stage do not at once fill up the gap left by the removal of the fourth and this fourth cell divides by itself just as it would have done if remaining in contact with the three others. It is only at a later stage that the products of isolated cells arrange themselves so as to form a complete, symmetrical individual.

A portion of the paper is taken up with certain abnormal methods of cleavage, beginning with the simultaneous formation of four instead of two cells, at the first cleavage. In these cases the cleavage continues to be *double*, a sixteen-cell stage having two sets of each eight cells comparable to the entire eight-cell stage of a normal egg. No larvæ could be reared from such eggs, yet special interest attaches to them upon the assumption that they owe their dual nature to a double fertilization. The only evidence that these eggs were fertilized by two sperms is the assumption by Fol and others that double fertilization causes the formation of four in place of the normal two first cleavage cells.

A most important addition to the methods of experimentation has resulted in unexpected results. It consists in subjecting echinoderm

[3]Entwicklungsmechanische Studien. Zeit. f. Wiss. Zool., 55, 1892.

eggs to mechanical pressure by the very simple expedient of allowing a cover-glass to rest upon them with more or less force as controlled by a hair inserted under the glass.

Eggs flattened out to several times their original diameter do not lose their power to develop, even when the egg membrane is ruptured. If the eggs are fertilized and undergo cleavage under pressure the resulting cells are not arranged in the form of a sphere but form a flat disk. This arrangement of the cells results from the arrangement of the nuclear spindles. While in a normal egg the spindles of the first four cells would stand vertically, as it were, and produce a new set of cells by a horizontal cleavage, under pressure the spindles are found all lying at right angles to the compressing force; that is, parallel to the cover glass or horizontally, and hence give rise to cells all lying in one plane. When the pressure is removed the cells remain at first in a flat disk, though each cell becomes rounded. Subsequent divisions of these cells give rise to a spherical mass capable of forming a complete normal embryo.

With the aid of figures the author makes it clear that in such cases material which would normally have taken part in the formation of only one pole or side of the embryo must now contribute to opposite poles or sides. In the sea-urchin there is thus no early specialization or differentiation of the material found in the cleavage cells; the mixing up of the blastomeres would not prevent the formation of a complete normal animal: the author concludes they could be mixed in all possible ways without destroying the normal symmetry of the adult.

In the philosophical discussion that takes up the final portion of the paper, the author considers the methods of morphological research and upholds the experimental method, which tends to promise the reduction of Biology to a scientific basis sooner than the descriptive, historical or mechanical lines of inquiry possibly can.

Studies in Insect Embryology.—Dr. H. Henking[4] having previously published extensive researches upon the formation, maturation and union of the sexual cells in *Pieris brassica* and *Pyrrhocoris apterus* concludes this comparative study with additional facts upon the eggs of the latter insect as well as those of *Agelastica alni*, *Donacia lampyris*, *Tenebrio*, *Lasius*, *Rhodites*, *Bombyx*, *Musca*, and other representatives of nearly all the chief groups of insects and then summarizes the whole with the aid of most interesting comparisons and suggestions.

[4] Zeit. f. Wiss. Zool., 54, 1892; 51, 1891; 49, 1890.

Along with the observation of normal processes, attempts were also made in some cases to influence these processes by increasing or diminishing the atmospheric pressure, by placing the egg in horizontal and vertical positions, by surrounding them with CO_2 and with O; but the results are not definite enough to afford more than suggestions for future work.

Regarding the maturation of the egg the author holds views that depend upon the interpretation of peculiar appearances seen in insect eggs, where, as is well-known, the technique is a most difficult factor.

The first polar body receives one-half of the chromosomes, one-half the normal number of the ordinary cell, and also the first *thelyid.* This *thelyid* or "acromatic polar body," is a rather vague mass of acromatic substance including the connecting filaments and adjacent substances between the two separating sets of chromosomes.

The second polar body receives the same number of chromosomes as the first, these being formed by a division of each, so that a half of each remains to form the egg nucleus; in some cases there is a second *thelyid,* but this remains inside the ovum.

The two polar bodies may separate completely from the egg, but more often they remain either in protoplasmic processes of its surface or entirely beneath its surface; the first polar body may divide into two.

Even when the polar bodies are extruded they may be later taken into the egg again. Their nuclei may undergo changes similar to that of the egg nucleus, either retaining the separate chromosomes or forming a chromatic network. The first and second or the product of the division of the first and second may fuse with one another inside the egg, much as the sexual pronuclei do.

Meanwhile numerous sperms may enter an egg; polyspermy in insects has no apparent injurious results. The sperm passes into the yolk in a bent attitude, with the union of head and tail preceding. A clear area about the sperm, the *arrhenoid,* seems to give rise to radiating striæ in the protoplasm. This peculiar body is regarded as formed from the acromatic connecting filaments given to the sperm at the second division of its mother cell; is thus comparable, in a way, to the *thelyid.* Increase in size and change in the sperms take place simultaneously in all that penetrate the yolk; only one meets and unites with the female pronucleus.

The number of chromosomes in the nuclei of ordinary somatic cells and in the cleaving egg is 28, 24, 20, 18–20, 24–30, in five different insects studied; the number in the first and also in second polar bodies in these same species, 14, 12, 10, 9, about 12. As far as studied the

spermatocytes have also this same half-number after their first and second divisions; with some interesting exceptions the sperm and the polar body and the female pronucleus have the same number, in any species, and this is half the number of other cells of that species.

With the aid of a diagram the author emphasizes the close parallel between the formation of sperms and polar bodies. Starting from a mother cell with, say 24 chromosomes, a *reducing* division forms two sperm mother cells, or in the female an egg and a polar body, in each of which are only 12 chromosomes, and these are half of the original 24, unchanged or undivided individually. A second division of each cell results in the formation of four sperm mother cells or in the female of three polar bodies, and the remaining egg, in each of which are 12 chromosomes. These, however, are formed by an *equal* division, that is, from the previous 12, 24 arise by a division of each—not by the separation of the whole set into two sets as in division with *reduction*. Later the 12 chromosomes of a sperm may be added to the 12 of the egg nucleus to make the normal 24 of the cleavage nucleus, whence, by equal division, all subsequent cells have 24 also. Likewise, in the insects, one polar body may unite its 12 with the 12 of another polar body.

Utilizing the recent researches of Guignard,[5] the author draws a most interesting comparison between the processes taking place in insects and in plants. Without the aid of diagrams this can scarcely be rendered intelligible; the most novel part, however, is an attempt to explain the polar bodies of animal eggs as, in a sense, "larval organs," somewhat comparable to rudimentary structures within the embryo sac of a flowering plant.

The fact that in insects the polar bodies may remain within the egg and that they, or their descendants, may unite with one another, seems to form a parallel to what takes place in the flowering plant. As is well-known, the embryo-sac cell forms two sets of each 4 nuclei within its substance, 4 lower antipodal cells and 4 upper cells, of which one is the ovum.

The formation of these is directly comparable to the formation of polar bodies in the animal—supposing a second series of divisions to supervene and convert the 4, ovum and three polar bodies, into eight. In the embryo-sac a remarkable fusion takes place between one of the antipodal nuclei and the sister cell of the ovum; this union forms the endosperm. Compared with the insect, this union is like the fusion of polar bodies, only in a later generation. In the insect nothing appar-

[5]See this Journal, May, 1892.

ently results from the fusion of polar bodies; they are rudimentary larval organs.

The fact that we here compare union of later generations in the plant with that of earlier ones in the insect or animal is perhaps made less objectionable by considering the state of things in the infusoria, where, as Maupas has shown, the final fusion takes place between nuclei resulting from more numerous divisions than are employed in the formation of sperm and female pronucleus.

The observations of Henking upon the number and division of the chromosomes in insects conflict in an important particular with the facts necessary to support Weismann's theoretical explanation of the use of polar bodies. In his "Amphimixis" Weismann holds that *reduction* takes place in the formation of both polar bodies, and that there was previously a doubling in the number of chromosomes or *idanten* to allow of greater complexity of combination of the *iden* or hypothetical hereditary units found in the chromosomes. Hinking denies that the second polar body is formed by *reduction;* it is formed by an *equal* division. Moreover, there is no previous doubling of chromosomes; the apparent doubling is only a more or less pronounced division into parts still remaining subservient to the whole, not acquiring individuality.

Weismann's views are moreover limited in that they depend upon the occurrence of two polar bodies, two divisions in the formation of sexual cells; whereas in plants and in infusoria, nuclei that need to copulate result from more numerous divisions.

Parthenogenesis again, as seen in hymenoptera and lepidoptera, may occur where two polar bodies with a smaller number of chromosomes are present.

Though recognizing the strength of the evidence that heredity is closely associated with the chromosomes, the author thinks they are not unchangeable, and that at times they may be more intimately combined with the other parts of the nucleus. If the centrosomes are to be regarded in heredity as of like value with the chromosomes then we must seek in them a process of reduction before copulation.

All present theories of fertilization and of inheritance have only a provisional character.

ENTOMOLOGY.[1]

On a Small Collection of Coleoptera from the High Mountains of British Columbia.—A small series of Coleoptera furnished the writer by Messrs A. G. Smith and F. Russell is of interest sufficient to deserve notice; the collection was made near Donald, B. C., on the top of the first range of mountains to the northeast and above the base of the snow line. Some of the beetles are circumpolar species, others are melanistic forms of those found in more favored situations. A list of them with remarks is appended:

Carabus oregonensis Lec.

One specimen of the insect was taken; it is darker than those found on the coast and somewhat smaller.

Nebria sahlbergii Fisch.

Numerous specimens of small size and with rather dark legs. This seems to have been the most common beetle on the mountain, and is characteristic of boreal or mountainous districts; it extends from the White Mountains of New Hampshire to Alaska, and Dr. Hamilton writes that he has it from the Coast Range of the south of California.

Bembidium incertum Mots.

One specimen; this is reported from Sitka, Alaska.

Pterostichus riparius Dej.

Four specimens; these are a little smaller than those from the coast of Southern Alaska, but about the same as a number from the Stikine River of British Columbia. It has been reported from Gray's Peak, Colo., at an elevation of 12,000 feet. Dejean described it from our northwest coast in 1828 (Species General des Coleopteres, iii, 333).

Amara remotestriata Dej.

Three specimens were brought from the mountain top. It occurs in mountainous and northern regions of our continent.

Harpalus innocuus Lec.

Two specimens of this species are very black, but present no other difference.

Hippodamia 5-signata Kirby.

A series of five specimens show great variation in size and color the smallest one being also the darkest. One of them is remarkable

[1]This department is edited by Clarence M. Weed, Hanover, N. H.

in that the thorax has a large, perfectly regular fovea on each side near the middle.

Hippodamia convergens Guer.

One specimen showing nothing of interest.

Coccinella transversoguttata Fabr.

One specimen of an ordinary type. Widely distributed in North America, and occurs also in Northern Europe and Asia.

Psyllobora 20-*maculuta* Say.

A specimen of this species is the most thoroughly melanized of any seen. All of the elytral spots, excepting the sub-apical, are more or less confluent, forming two irregular vittæ—one near the suture, the other discal. This would go under the variety *tædata* Lec., but is larger than typical 20-*maculata* instead of being smaller, as is usual with that variety.

Byrrhus kirbyi Lec.

One specimen.

Byrrhus cyclophorus Kirby.

Two specimens. This and the preceding species are northern or montane in habit.

Buprestis lanta Lec.

One specimen.

Podabrus xanthoderus Lec.

Four specimens of a *Podabrus* which agree with Dr. Leconte's short description of his variety *a* (Trans. Amer. Ento. Soc., ix, p. 48), are referred here. The mandibles and sides of the head are yellow, as are also the antennal tubercles and the first two joints of the antennæ. One specimen (possibly a distinct species) has the thorax entirely black, except a very narrow margin on the sides in front of the middle; it is also a little less in size, but seems to agree in other characters.

Aphodius ursinus Mots.

Two specimens of this fine insect are in the lot. It is a black variety of *aleutus*, according to the latest researches and is known from Colorado (Dr. Horn, Trans. Amer. Ento. Soc., xiv, p. 13) and from Kamtschatka. Compared with examples of *aleutus* from Southern Alaska these latter are only about half as large.

Aphodius granarius Linn.

Four rather large specimens. This species is found over nearly all of North America and the rest of the civilized world.

Aphodius congregatus Mann.

One specimen of the variety with testaceous elytra.

Acmæops proteus Kirby.

A specimen of this variable species is almost exactly like one from Ottawa, Canada.

Syneta albida Lec.

One specimen. The suture is narrowly dark, the thorax and head also quite dark. The species of *Syneta* vary in color and it is quite unnecessary to erect new species on such characters until the extent of this variation is more definitely known.

Gonioctena arctica Mann.

Four specimens of this interesting species were taken, two of them nearly typical, differing from Mannerheim's description (Bulletin de la Societe Imp. des Naturalistes des Moscow, 1853, p. 166) only in the absence of the pale thoracic borders and dorsal line. The remaining two show both of these markings very well, but differ from each other in minor particulars. As the species is rare in American collections I

FIG. 1.

have prepared the accompanying figure, which will give some idea of the color variations exhibited even by a small set. This species is known from Northern Alaska, the Nelson and Churchill Rivers and from Arctic Siberia southward to the Amur, according to Dr. Hamilton, from whose valuable paper (Trans. Amer. Ento. Soc., xvi, p. 88 *et seq.*) much of the distribution herein quoted is derived.

Serropalpus barbatus Schall.

One specimen occurs "from Maine to Alaska, Central and Western Europe, Western and Eastern Siberia." (Hamilton.)

H. F. WICKHAM, Iowa City, Iowa.

A Peculiar Seed-Like Case-Worm from the Grand Canyon.—While collecting in the Grand Canyon, July 8 to 11, 1892, the members of our party frequently found themselves covered with num-

bers of very small, thin, seed-like bodies, which became attached to their arms, hands, clothing, and faces. Examination proved these to be the cases of a very small larva, which lived within. They were afterward observed to be very common on the narrow-leafed willows (*Salix* sp.), a round-leafed species of leguminous tree, and on many, other plants. They were usually found on the edges of leaves, the

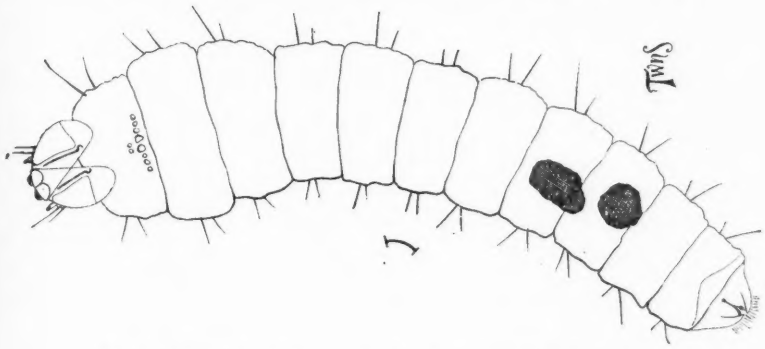


Fig. 2.—Larva, dorsal view—much enlarged. (Hair line shows natural size.)

case being attached thereto by a few extremely fine strands of silk. They occurred especially on the *Salix*, and were found at 2500 feet and more below the rim.

An examination of this larva proves it to be lepidopterous. It has not been bred, but the description of the larva and case given below, together with the figures, will serve to identify it. It is peculiar as exhibiting no trace of legs or prolegs, yet it is unmistakably lepidopterous.

Description of Larva.—Body 13-jointed, whitish, very sparsely clothed with weak hairs; head and second segment with anal hooks, somewhat rufous. Head narrower than second segment, a little more than one-half as wide, subcircular in outline from above, widely and deeply notched behind; two small approximated simple eyes on extreme outer anterior edge of lateral dorsal plates of head just back of antennæ, the anterior one slightly larger than the posterior. Antennæ small, short, 3-jointed; first joint stout, a little longer than wide, with terminal bristles on outer edge; second joint very small and short; third joint a little narrower and longer than second, coming to a point at tip. Mandibles stout, narrowed and twice-notched

(3-toothed?) apically. First pair of maxillæ 3-jointed, joints about equal in length, basal joint stoutest, second and third joints decreasing in width; two pairs of palpi springing from inner side of basal joint, these palpi apparently also 3-jointed, joints of equal length, basal stoutest, second and third successively narrowed. Second pair of maxillæ with one pair of palpi, these palpi apparently 2-jointed, first joint moderately narrow, terminal joint elongate, bristle-like, tapering to a

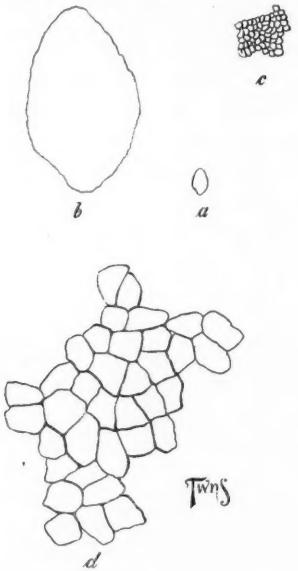


Fig. 3.—*a*, case—natural size; *b*, case—enlarged; *c*, portion of case—enlarged; *d*, portion of case—greatly enlarged.

point; spinneret 3-jointed, joints sub-equal in length, basal joint stout, terminal joint pointed. Second segment corneous, with a transverse row of about eight roundish markings near posterior margin, and a median pair just anterior to row. Other segments fleshy, the integument of all segments except head microscopically warted, in the present alcoholic specimen much wrinkled, especially on third segment; third segment somewhat wider than second, fourth a little narrower, segments 5 to 10 about same width, 11 to 12 nearly as wide; segments 2 to 12 subequal in length. Thirteenth or anal segment narrowed, shortened, longitudinally bifid on the median line posteriorly, fur-

nished with a pair of curved claw-like corneous hooks springing from sides of ventral surface, their tips closing on each other posteriorly. (Ninth and tenth segments each with a black circular or oblong contained body.) Spiracles showing on eleventh and twelfth segments as small nearly circular openings about the middle of segment near lateral margin, not apparent on other segments. No indication of true thoracic legs or of prolegs.

Length of larva (slightly curved as in drawing), $2\frac{3}{5}$ mm.; width of third segment (second from head), about $\frac{3}{5}$ mm.

Description of Case.—Case is small, seed-like in shape, very flat and thin, a little longer than wide, pale brownish in color, composed of two thin layers sub-oval in outline, glued together on edges, narrowly separated or free at one end, the larva living between the layers. Under the microscope a single layer presents a reticulated structure, appearing as if uniformly made up of very small irregular pieces of nearly equal size. It is apparently composed of vegetable tissue, probably very minute fragments of leaves.

Length of case, about $3\frac{1}{2}$ mm.; greatest width 2 mm., or hardly more.

C. H. Tyler Townsend.

Entomological News.—At the meeting of the American Association of Agricultural Colleges and Experiment Stations held in New Orleans, Nov. 15 to 18, Chairman Lawrence Bruner, of Nebraska, and Secretary F. M. Webster, of Ohio, of the Entomological Section, were reelected for another year. But few entomologists were in attendance at the meeting, most of the Station entomologists seeming to prefer the Association of Economic Entomologists for the presentation of papers in reference to their work. The report of the Chairman of the Section of Entomology, Prof. Lawrence Bruner, was read by Prof. Osborn. The report largely consisted in a statement of the equipment of the Station entomologists as a whole, to which was added a statement in detail of the entomological equipment of each station having an entomologist. The report showed that while some of the stations were well equipped with laboratory, insectary, and other requirements for work, yet there were many stations which had not given entomologists proper equipment. Some of the Station entomologists lack room for laboratory, others library, and many, microscopes. Valuable results of a practical as well as a scientific nature are rarely attained without proper apparatus, and the Station entomologists need something more than jack-knives with which to carry on their work.

It is gratifying to learn of the advancement being made by many of the entomologists of the experiment stations. Prof. H. A. Morgan, of Louisiana, and Prof. Popenoe, of Kansas, who were formerly entomologists and horticulturists of their respective stations, have, upon their urgent request, been made entomologists of their stations only. This is a step in the right direction.

Prof. John B. Smith will have charge of the entomological part of the biological exhibit of the office of experiment stations at the World's Columbian Exposition.

Howard Evarts Weed, of the Mississippi Agricultural College is making a special study of North American Myriopods, and would be glad to exchange insects of any order for Myriopods of any locality, especially the west. His address is Agricultural College, Mississippi.

Prof. C. H. T. Townsend is preparing a monograph of North American Tachinidæ, and desires material in this family from any locality, especially bred specimens. His address is Las Cruces, New Mexico.

A recent issue of *Psyche* says: "Entomologists everywhere will regret to hear that the serious illness which has, for the past two years, incapacitated Dr. H. A. Hagen, renders it improbable that he will be able to do any further work. Dr. Hagen has had charge of the collections of insects in the Museum of Comparative Zoology at Harvard University since Oct. 12, 1867, and during this long period of twenty-five years has applied himself with entire devotion to the interests of the department. The scientific value and present excellent condition of the collections are the result of his faithful and disinterested work. Recently the department has been placed in charge of Mr. Samuel Henshaw."

Dr. M. C. Cooke, the well-known English mycologist, has brought together an account of the fungi parasitic upon insects in a volume recently published by the Society for Promoting Christian Knowledge (London, 1892).

We learn from *The Entomologists Monthly Magazine* that Mr. Oswald Latter reported at a recent meeting of the London Entomological Society that the moth *Dicranura vinula* produces, probably from the mouth, a solution of caustic potash for the purpose of softening the cocoon.

An interesting summary of the value of entomological study has been sent out by Mr. James Fletcher in the report of his Evidence before the Committee on Agriculture of the Canadian House of Commons.

PSYCHOLOGY.

Vision in a Young Girl Six Years of Age, Operated Upon for Double Congenital Cataract.—M. Grafé has published in the *Revue Scientifique* July 16, 1892, an interesting account of an operation for double cataract, performed by M. Bribosia upon a blind girl 5 years of age, and discusses, in the same paper, some questions of sight psychology. This reminds me of a similar operation performed by myself several years ago upon a young girl 6 years old, born with a double white cataract. Some notes of that operation, which I have kept, will perhaps be of use to M. A. Grafé in the researches he has undertaken in a new field.

What are the sensory impressions and emotions of a person born blind when the veil which has hidden from him the marvellous world is suddenly rent? Would he, at first sight, see, as has been taught, objects reversed, in consequence of the crossing of the rays of light from the object before their contact with the retina? Would he have intuitively an idea of distance and of the third dimension of matter, or would this idea be gained by observation and experience?

In order to succeed in solving the problems of optical physics and visual psychology, M. A. Grafé arrived a little late after the operation by M. Bribosia. I had opportunities in the case of the child 6 years of age, more advantageous for studying the curious phenomena which took place, not only during the operation, but also during the dressing of the wound and the first exercise of the newly acquired sense.

The following are the notes of the operation:

Julie D. had a double white congenital cataract at the age of 6 years. She perceived less and less from infancy the light of day, even after the local use of belladonna. Being intelligent, she had acquired a variety of knowledge from conversation. Touch and hearing had become very sensitive, and her memory was excellent.

I operated upon both eyes at the same time, as was my custom with double cataract in old people as well as young. But, in order to avoid a sudden flood of light, I operate always in a slightly darkened room; and before attending to the second eye, I hermetically seal the first with a simple bandage. The dressing of the wound for the first few days is done in the same manner in a similarly darkened room.

When I allowed Julie D. for the first time to remove the bandage from her eyes she had a slight sensation of dizziness, which made her

put her hands to her face. Then she saw at a little distance objects which she recognized by their shape; a coffee-mill, my hands, knives, forks, a plate, a cup, a watch, a handkerchief, etc., the forms of which she had become familiar with through touch during her long blindness. But she could not distinguish color. She would make hap-hazard guesses at red, green, blue, and yellow, but could sometimes recognize black and white. I was anxious to know her first optical impression as to the position of objects whether they appeared right or reversed. With this idea in mind I showed her, first of all, a coffee-mill, held at the distance of a meter from her, and said, "What is this?" "My coffee-mill," said she without hesitation. "How do I hold it, with the drawer on top or on the bottom?" "It is below, as it ought to be." Thinking that the child was answering in accordance with her preconceived notions contrary to her first visual sensation, I showed her a knife fixed vertically by two threads to a sheet of white paper, and asked her to show me with her hand where was the handle of the knife, at the top or the bottom of the paper. She pointed immediately with her right hand to the handle, saying: "It is there, at the top." This was correct.

I did not indulge my scientific curiosity further at that time. At the second and third interviews which took place the sixth and seventh day after the operation, Julie was no longer deceived as to colors, but she still imagined as she had at first, that everything she saw was within reach. Space, height and volume did not as yet exist for her. However, she appreciated perfectly the distance of sounds. When objects were held for her at less than a meter's length, she would instinctively draw back, feeling, as she said, that they would strike her eyes. As to everything she saw that was at more than arm's length, they all seemed ranged on the same line, that is, all seemed equally distant. But this illusion did not last long. The sense of touch had given her such just ideas of the form, the size, and the different dimensions of buildings, persons and the objects in the midst of which she had lived, that ideas of perspective and appreciation of distances were speedily acquired.

At the end of fifteen days she said she had almost forgotten that she had ever been blind.

Had she, in the presence of what we call the wonders of nature, the flowers, the trees, the monuments, the country, the storms, the sky with its myriad stars, the sun and the moon, that awakening of the imagination roused by a spectacle as magnificent, as unexpected, which expresses itself in an ecstatic admiration? She was astonished at all,

but she admired nothing. Had she dreamed, perhaps, during that long night of six years more and better things than the realities which unfolded themselves before her eyes?

It is a fact that the persons who have lost their sight, and recovered it through an operation, have shown more pleasure at seeing again their relations, their friends, and their coffee-mills than did Julie D. at seeing for the first time all the objects of which she could have had only a feeble and imperfect idea gained either through the sense of touch or from descriptions given her by others.—H. Boëns, Revue Scientifique, Oct. 29, 1892.

ARCHÆOLOGY AND ETHNOLOGY.

Area and Population of European Countries.—M. E. Lavasseur, in a communication to the Academie des Sciences on March 21, 1892, calls attention to the diversity usually to be found in statistics of area and population in standard works of reference. Considering only such high class publications as "Die Bevölkerung der Erde," the "Almanach de Gotha," and the "Statesman's Year-Book," he points out that diversity does not necessarily convict any of error, as the approximation to the exact figures may be arrived at in different ways; that, in fact, absolute agreement in statistics is a sign that they have been copied by one writer from another. In some cases the areas of countries are officially derived from cadastral surveys, which, as a matter of fact, often do not include the whole land and water area of a country, geographers not being agreed as to what water areas should be reckoned along with the land. In other cases official or semi-official measurements are made on large-scale topographical maps, and the degree of approximation must vary with the scale, and with the technical skill of the computor. Some countries are content with measurements or estimates made by individuals, such as those of Strelbitsky and of Perthes' Institute. The calculation of population is still more uncertain, being dependent on census returns (themselves imperfect), calculated to any given intermediate date by estimates derived from registers of births, deaths, immigration and emigration. In a table brought down to the end of 1890 M. Levasseur gives a conspectus of the area, population, and density of population of the countries of Europe, classed in four groups, as follows:

	Inhabitants.	Area, sq. m.	Density per sq. m.
Western Europe.....	87,100,000	352,300	247
Central Europe.....	93,609,000	464,400	200
Southern Europe.....	71,826,000	557,800	130
Eastern Europe.....	98,000,000	2,106,500	47
Northern Europe.....	9,100,000	378,000	23
All Europe.....	359,635,000	3,859,200	93.1

Notes as to the various estimates are appended; those relating to the German Empire may be cited as an example. The "Bevölkerung der Erde" in 1872 gave the area as 207,816 square miles; in 1874 as 207,935; in 1876 as 207,943; in 1878, as in 1880 as 207,883; in 1882 as 207,899; in 1891 as 207,861; while Strelbitsky's measurement is 208,008, and that adopted in the tables from the "Statistisches Jahrbuch für deutsches Reich" for 1891 is 207,929 square miles.—Proceeds. Roy. Geog. Soc., July, 1892.

A Measure of Civilization.—Dr. Lamborn suggests that the proportionate length the artist gives the face or head to the body might be considered a measure of civilization. He finds that the late Spanish artists give 10½ faces to the height. Dürer 10 to 1. Earlier Spanish artists 9 to 1. The measurements of a number of wood cuts of the Fifteenth Century run 5½ to 1 and 6½ to 1. The Mexican images are 4 to 1, 3½ to 1, and 3 to 1. The gold figures of Peru make the head larger than the body. (Lamborn's History of Mexican Art.)

MICROSCOPY.[1]

On the Restoration of Osmic Acid Solutions.—The osmic acid so valuable to the histologist as a fixing reagent, is known to the chemist as osmium tetroxide, $Os\ O_4$, and is one of the series of osmium compounds with oxygen. It is readily reduced in the presence of an organic substance, giving up two atoms of oxygen and forming the deutoxide, $Os\ O_2$. This is the well-known black powder so familiar in specimens killed in any of the fluids into which osmic acid enters. Osmium tetroxide affects fatty substances first, and these are the substances that most readily undergo oxidation. Prolonged exposure to the action of the tetroxide blackens the tissue so that it is useless for histological purposes.

In preparing stock solutions of osium tetroxide the greatest care must be taken to exclude organic matter, even acetic acid in the quantity called for in Flemming's stronger fluid, is liable to cause the reduction of the tetroxide. A trace of impurity in the distilled water sooner or later produces the fatal blackening, while a solution made with pure water will keep indefinitely in the light. Let but a trace of dust fall into the bottle and reduction will take place to some degree.

During the summer of 1892, at the Marine Biological Laboratory at Woods Holl, Mass., a large number of solutions were treated with peroxide of hydrogen, $H_2\ O_2$, and different investigators tested them with uniformly good results. The restored solutions acted in the same manner as the fresh solutions, and produced the same results; the only noticeable difference was a gradual weakening of the solution, as would naturally be expected. Specimens overblackened by the action of the peroxide were rendered colorless without perceptibly changing the character of the tissue, and a few experiments were made to determine whether the bleaching with peroxide could be so controlled as to leave certain tissues blackened while others were cleared. This quantitative bleaching with peroxide yielded no very good results in the few experiments made, but enough was accomplished to warrant further attempts.

The chemistry of the restoration and the bleaching further demonstrates that no injurious factor enters into the result as is shown by the following equations:

[1]This department is edited by C. O. Whitman, University of Chicago.

$Os\ O_4$ + organic substance = $Os\ O_2$ + oxidized organic substance.
$Os\ O_2 + 2H_2O_2 = Os\ O_4 + 2H_2O$.

That is, in bleaching a tissue, the $Os\ O_2$ is converted into $Os\ O_4$, and water is formed, with which the tissue is already saturated.

To restore 100 cc. of a 1% solution of osmium tetroxide requires from 10 to 20 drops of fresh peroxide of hydrogen, and clearing goes on better in full sunlight. To bleach tissue with peroxide requires about the same amount in 100 cc. of water, and the bleaching takes place better in the sunlight also. The amount needed cannot be stated with any more precision because the peroxide loses its strength somewhat with age. The peroxide made by the Oakland Chemical Co., 54 South Avenue, New York, is more stable and keeps better than many of the preparations in the market.—C. L. Bristol.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The Geological Society of America.—The Fifth Annual Meeting was held at Ottawa, Canada, on December 28, 1892, and following days. The following papers were read: Notes on the Early Palæozoic Sponges, Sir J. William Dawson, Montreal, Can.; Notes on the Devonian Formation of Manitoba and the N. W. Territories, J. F. Whiteaves, Ottawa, Ont. The object of this paper was to show the relationship of Devonian formation of Manitoba and the N. W. Territories with that of Northern Europe. In Manitoba the Stringocephalus zone is remarkably well developed and holds a rich fauna, whereas in the Mackenzie River district, most of the fossils so far collected seem to be from the Cuboides zone. On the Coals and Petroleums of the Crows's Nest Pass, Rocky Mountains, A. R. C. Selwyn, Ottawa, Ont.; On the Geology of Natural Gas and Petroleum in Ontario, H. P. Brumell, Ottawa, Ont. A brief résumé of work done in gas and oil explorations in Ontario, and dealing with the geological evidence adduced from record of wells sunk. Including also a short account of the geology of Southwestern Ontario. Some Features of the Phosphate Bearing Rocks of Ottawa County, P. Q., Elfric Drew Ingall, Assoc. Royal School of Mines, Eng. (Introduced by J. B. Tyrrell.) This was a preliminary paper, based upon field observations, discussing the phenomena exhibited by the Apatite deposits and their associated rocks in their bearing upon the question of the probable mode of formation of these deposits. Some Maryland Granites and Their Origin, Charles Rollin Keyes, Des Moines, Ia. A brief sketch of the granite

rocks of Maryland, with a summary of the reasons for regarding them as eruptive in origin. Epidote as a Primary Component in Granites, Charles Rollin Keyes, Des Moines, Ia. Occurrences of the mineral in certain granites regarded as eruptive described, the evidences of its original nature explained and its associations with the closely related Allanite considered. On the Laurentian of the Ottawa District, Robert W. Ells, Ottawa, Ont. The paper briefly reviewed the work of the late Sir Wm. Logan in this district, forty years ago, and discussed the structure of the calcareous portion of the system, more particularly as regards the relationship of the crystalline limestones to the underlying gneiss; with a brief statement of the several kinds of intrusive rocks which penetrate both the gneiss and limestone, and their apparent influence upon the occurrence of the economic minerals, such as graphite, apatite and mica. The Contact of the Laurentian and Huronian North of Lake Huron, Robert Bell, Ottawa, Ont. The line of contact between the Great Huronian Belt to the northward and the Laurentian area to the southward was traced from near Killarney on Lake Huron to its intersection with the Ottawa River. The two sets of rocks in this region were described with regard to their structure and their relations to one another. The nature of their contact here and in other instances in Canada was described in connection with the question of the conformability or otherwise of the two systems. Reference was made to the extraordinary development of quartzite in the LaCloche region, to certain forms resembling fossils lately discovered by the writer in the Huronian rocks of the vicinity, to the greenstone masses and dykes, to the nature of the granites and to other points in connection with the geology of the district. The marked dependence of the physical geography upon the phenomena of crystalline rocks of the region was likewise pointed out. The Archæan Rocks West of Lake Superior, W. H. C. Smith, Ottawa, Ont. (Introduced by R. W. Ells.) This paper gave a brief description of the rocks and their distribution between the Lake of the Woods and Lake Superior north of the International boundary and referred to some of the theories of origin and structure of the various members of the Archean system and to the iron ores and gold-bearing rocks of the region. On the Archean of Sudbury Mining District, Alfred E. Barlow, M. A., Geological Survey Department, Ottawa, Ont. This paper related in detail the various phenomena in connection with the contact between the Laurentian and Huronian to the northeast of Lake Huron, with a discussion of the origin and relative age of each, based on these observations. Notes on Cambrian Fossils from the

Selkirks and Rocky Mountain Region of Canada, Henry M. Ami, Ottawa, Ont. This paper was based mainly upon a collection of Lower and Middle Cambrian fossils made by the author in the summer of 1891. It contains notes on some eight species of Lower Cambrian (Olenellus zone) fossils from the gray, glossy and calcareous schists and limestones of the entrance to the Selkirks, some two miles west of Donald, British Columbia. The latter part of the paper dealt with the forms met with in the Middle Cambrian of Mount Stephen in the Rocky Mountains, near Field, B. C., where the terrane is highly fossiliferous. Upwards of twenty species have been recorded from this locality, many of which are very interesting and well preserved. On the Potsdam and Calciferous Terranes of the Ottawa Paleozoic Basin, Henry M. Ami, Ottawa, Ont. The stratigraphical, lithological and paleontological relations of the Potsdam and Calciferous terranes, as seen and known in the Ottawa palæozoic basin and elsewhere were discussed in this paper; also the reference of these two terranes to the Cambro-Silurian or Ordovician Epoch instead of to the Cambrian Epoch, inferred from the internal evidence. The Criteria for the Recognition of Separate Ice Epochs, R. D. Salisbury, Chicago, Ill.; Note on the Geology of Middleton Island, Alaska, George M. Dawson, Ottawa, Ont. This short paper was devoted principally to the description of a boulder-clay or till from Middleton Island, which is found to contain some marine fossils. Eskers Near Rochester, N. Y., Warren Upham, Somerville, Mass. The Pinnacle Hills, a very remarkable esker series in the southeastern suburbs of Rochester, were described and attributed to deposition by a glacial river flowing between walls of ice and open above to the sky. Their material, which is shown to have been englacial, is chiefly gravel and sand, but also comprises in some parts very abundant and large boulders, some of which are lifted 200 feet or more above their sources within a few miles on a nearly plain country. Similar explanations are also applicable to other eskers in Pittsford, several miles farther southeast. Comparison of Plistocene and Present Ice-Sheets, Warren Upham, Somerville, Mass. The Plistocene ice sheets of North America and Europe were compared with the now existing Malaspina, Greenland, and Antarctic ice-sheets, as to their areas, surface slopes and probable thickness, rates of erosion and ablation, subglacial and englacial drift, and manner of deposition of various drift formations. The Malaspina glacier or ice-sheet, covered on its wasting borders by much drift and growing forests, is believed to afford explanations of forest beds between deposits of till, and of the peculiar drift accumulations named drumlins, both

being attributable to stages in the general recession of the North American ice-sheet when increased snowfall and onflow of the ice slackened its retreat or caused it temporarily to re-advance. Under this view, the Ice-Age seems probably to have comprised only one great epoch of glaciation, with moderate oscillations of the ice-front, and to have been geologically brief. Pliotocene Phenomena in the Region Southeast and East of Lake Athabaska, Canada, J. B. Tyrrell, Ottawa, Can. The paper was the result of an exploration conducted by the writer during the past summer in the hitherto unexplored region lying southeast of Athabaska Lake and north of Churchill River. The region has some strongly marked glacial features. The writer disdiscussed the striation and character of the rock surfaces, the occurrence of till, drumlins, kames, and other glacial phenomena. Some high-level beaches, terraces, and other post-glacial deposits were also noted. Notes on the Glacial Geology of the Northeast Territories, A. P. Low, Ottawa, Ont. A short account of the geography and surface geology of the western water-shed of Labrador Peninsula, derived from explorations on the Rupert, East Main, Big, Great Whale and Clearwater Rivers, and along the east coast of Hudson Bay. Notes on the Gold Range in British Columbia, James McEvoy, B. A. Sc., Ottawa, Ont. (Introduced by H. M. Ami.) A short description of the topography of the Gold Range and part of the adjoining Interior Plateau country, with notes on the glacial geology of the same. The Glacial Gravels of Glacier Bay, Alaska, Harry Fielding Reid, Cleveland, Ohio (Introduced by J. S. Diller). The Post-glacial Outlet of the Great Lakes Through Lake Nippissing and the Mattawa River, G. Frederick Wright, Oberlin, O.; The Height of the Bay of Fundy Coast in the Glacial Period Relative to Sea Level, as Evidenced by Marine Fossils in the Boulder Clay at Saint John, New Brunswick, Robert Chalmers, Ottawa, Ont. Description of locality, area and thickness of boulder-clay. Divergent striæ on underlying rocks. The materials of the boulder-clay from the north. Intercalated stratified portions and their fossils deposited in the sea. Sections at Fern Ledges and Negrotown Point given. The conclusions are that the climate was Arctic or subarctic; that the boulder clay here was formed by a number of successive accretions in a zone of osciHation of the ice-front, and that its upper portion at least was thrown down when the lands stood 100 to 200 feet below its present level. On Certain Features in the Distribution of the Columbia Formation on the Middle Atlantic Slope, N. H. Darton, Washington, D. C. This paper was a description of relations indicating an interval of erosion between the depositions of the

high-level and low-level portions of the formation, beginning in Southern Maryland and gradually increasing northward to New Jersey. A Geological Reconnoissance in the Central Part of the State of Washington, Israel C. Russell, Ann Arbor, Mich. The region traversed embraces about 10,000 square miles in the arid region east of the cascades and drained by the Columbia. The reconnoisance was made for the purpose of learning how far the conditions there existing favor the project of obtaining artesian water for irrigation. The following is a syllabus of the paper.

Geography of the region explored.
Geological formations.

Crystalline rocks. Kittitas system. Columbia lava. John Day system.	Tertiary.	Glacial records, Lake Lewis,	Pleistocene.

Geological structure. Existing lakes. Artesian water supply.

The Abandoned Strands of Lake Warren, Andrew C. Lawson, Berkeley, Cal. The strands of Lake Warren, on the north side of Lake Superior, up to an elevation of 1200 feet above sea-level are post-glacial. It was not an ice-dammed lake. There was an outlet northward corresponding to one of its higher stages. A post-glacial depression of Central Canada whereby the James Bay slope was covered with marine sediments to a present altitude of 450 feet above tide and only 150 miles distant from Lake Superior is correlated with the maximum fullness of Lake Warren, and the subsequent uplift is correlated with its subsidence. The strand lines show no evidence of deformation. In the absence of ice dams and of a gorge of permanent drainage, the Level of Lake Warren could only have been lowered by epeirogenic depression along its southeastern margin, *i. e.*, in the region south of Lakes Huron and Michigan, which depression is thus coeval with the post-glacial uplift of central Canada. High terraces and beaches are known to extend along the north side of Lake Huron from Sault St. Marie eastward and they are reported on the high lands of the Peninsula of Ontario; so that Lake Warren must have been the greatest of the known Quaternary Lakes. Its area is roughly estimated at 150,000 square miles. The Importance of Photography in Illustrating Geological Structure, R. W. Ells, Ottawa, Ont. In connection with this paper was shown a series of large photographs by Topley, taken under the direction of the writer, showing more clearly the mode of occurrence of the apatite in the deposit of the Buckingham and Lievre district, as well as the relations of the intrusive

apatite-bearing rocks to the surrounding gneiss. · Two Neocene Rivers of California, Waldemar Lindgren, Washington, D. C. It was the purpose of this paper to briefly indicate the direction and grade of the *principal forks* of the Neocene equivalents of the present Yuba and American Rivers. These streams now drain an area in which many important Neocene gravel deposits are located, and to trace the old water courses is of the highest importance in order to successfully open and mine the auriferous channels. The results recorded here have been reached during the course of the investigation of the Gold Belt carried out under the direction of Dr. G. F. Becker, by the U. S. Geological Survey.

The geological events related to the accumulation and covering up of the Neocene channels were briefly sketched and the different systems of channels described. The fact was accentuated that the Neocene rivers closely correspond to those of the present day in the extent of their watersheds, although by no means always in the direction of their principal forks. A short statement was given of the work previously done in the same field by other investigators.

The course of the Neocene Yuba and American Rivers was described, by the aid of a map, on a small scale. In places where differing results have been obtained from those of other observers, or where new facts have been brought out, a more detailed statement was given. *Practical results:* The greater part of these Neocene channels is now covered by heavy masses of volcanic material and many of them, though auriferous, have not yet been opened for mining operations. The continuity of certain channels under the lava cap can be asserted and their approximate positions indicated; some of them, most likely to prove remunerative, but which have not yet been opened up, were mentioned; among them are the Blue Tent Channel, the Long Canyon Channel, and the Webber Creek Channel.

Boston Society of Natural History.—Dec. 21.—The following papers were read: Some New Experiments on the Absorption of Liquids by Aerial Parts of Plants, Mr. W. F. Ganong; The Abdominal Pouch of Butterflies of the Genus Parnassius, Mr. S. H. Scudder; Columnar Structure in Stratified Rock, Prof. W. H. Niles.

January 4, 1893.—The following papers were read: Account of Some of the Botanical Establishments of Europe (photographs were shown), Prof. W. G. Farlow; Application of the Microscope to the Study of Rocks (colored stereopticon views were shown), Dr. J. Eliot Wolff.

SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences, Biological Section.—Meeting of Dec. 12.—The following is a synopsis of the papers: On the Miocene Deposits of the White River, by Dr. J. L. Wortman; These deposits were arranged in three groups, *lower* or *Menodus* beds, *middle* or *Oreodon* beds, and *upper* or *Protoceras* beds. The *Protoceras* beds were regarded as in part contemporary with the *John Day* beds of Oregon. On the ileo-colic junction of Procyon lotor and allied Arctoids, by G. S. Huntington. The absence of cæcum in Procyon was noted as repeating the condition found in Hyæna and the Ursidæ. The provision for preventing return of contents of large intestine appears to consist in a series of constrictions in the terminal part of the ileum together with increase in the circular muscular fibres in these situations as well as at the ileo-colic junction itself. There is a complete absence of an ileo-colic valve. On the Origin of West Indian Bird Life, by F. M. Chapman. Conclusions from study of bird and mammal life were (1) distinctness geologically of Lesser from Greater Antilles; (2) independence of islands from mainland since the appearance of the present fauna; (3) original connection of West Indies to Central America by way of Jamaica; Central America at this time an archipelago created by passage leading from Pacific to Carribean Sea; (4) the older faunal forms of the West Indies represent survivors of the insular Tertiary species; (5) the newer forms are immigrants and become differentiated under new conditions of living. H. F. Osborn reported the discovery in the Miocene of South Dakota of a horned artiodactyle represented by male and female skulls and complete fore and hind feet. The female skull is comparatively hornless and proves to be identical with *Protoceras celer* Marsh. The male skull exhibits no less than five protuberances upon each side or ten altogether. Two of these upon the frontals and sides of the maxillaries are very small; the parietal, supraorbital and maxillary protuberances are very prominent and had apparently a dermal covering as in the giraffe. There are four toes in front and two behind as in the early Tragulidæ. The types were found by Dr. J. L. Wortman, and are in the recent collections of the Am. Mus. Nat. Hist.

BASHFORD DEAN, *Sec. Biol. Section.*

Natural Science Association of Staten Island.—Nov. 12, 1892.—The election of officers for the ensuing year resulted as follows: President, Walter C. Kerr; treasurer, Thos. Craig; recording secretary, Joseph C. Thompson; corresponding secretary, Arthur Hollick. A paper on Our Historic Landmarks, by Mr. Ira K. Morris, was read by

title, and will be published as a "special" later on. Dr. N. L. Britton presented specimens of *Aspidium cristatum* (L.) Sw., collected by Mrs. N. L. Britton, near Oakwood. This fern is exceedingly rare on Staten Island, having been previously reported from but two localities, in one of which, the Clove Lake Swamp, it has been since exterminated.

Mr. Arthur Hollick read the following paper Upon Additions to the Cretaceous Flora of Staten Island.

At the meeting of January 2, 1892, I gave a preliminary account of the Cretaceous fauna and flora of the island so far as studied up to that date. At the meeting of March 12, the rediscovery of fossil leaves in the Kreischerville clays was recorded, and also the discovery of a large fossil leaf near Richmond Valley. At the meeting of September 10 the discovery by Mr. Heinrich Ries of fossil leaves in the Cretaceous clay at Green Ridge was recorded and since that time Mr. Wm. T. Davis has turned over to me a number of other specimens found by him in the clay at Kreischerville.

All this new material and such of the old as had not been critically examined has been the subject of careful study by me during the past few months with the result that there has been added at least thirty-eight species to our Cretaceous flora.

Most of them were known previously from the clays of Woodbridge or Amboy, N. J., but others have not before been reported from Eastern North America and we here have their first recorded occurrence in this region. Of these fourteen represent species new to science.

The specimens have all been shown from time to time at our meetings, and from these careful drawings have been made. The entire subject will be presented before the New York Academy of Sciences shortly, with full descriptions and figures of all the new species, which will be published in the Transactions in due time.

We have forty-seven species representing the flora of the Cretaceous formation on Staten Island. All the specimens from Tottenville, Richmond Valley, Princes Bay and Arrochar are in ferruginous rock of a concretionary character and are well preserved. Those from the clays of Green Ridge and Kreischerville soon began to disintegrate upon exposure to the air and are now mostly useless for purposes of identification.

Dec. 17, 1892.—A specimen of European "Gorse" or "Furze," sent by Dr. F. Hollick, was shown and the following memorandum read:

The accompanying specimen was obtained Nov. 10, from a small bush, about a foot in height, of European furze (*Ulex europæus* L.), which is growing wild on Ward's Hill, Tompkinsville. I first discov-

ered it during the early autumn. To all appearances the plant is self-seeded, and is remote from any garden or cultivated ground. The only other vegetation in the vicinity is short stunted grass, so that the bush in spite of its small size, is a conspicuous object and has probably only escaped destruction by reason of its sharp prickly foliage. The locality is strikingly similar to the "commons" or "downs" where it grows in Great Britain. How it came here is a mystery, as the only other place where it is known to occur in America, so far as I am aware, is on the Island of Nantucket, where it was introduced about 1860, and has since spread to some extent. If protected and encouraged it would doubtless become established here and spread as it has done in the latter locality.

Mr. William T. Davis exhibited *Cecropia* cocoons which had been partly destroyed by woodpeckers, and read the following paper on woodpeckers and cecropia cocoons.

The caterpillars of the *Cecropia* moth spin their cocoons in a variety of places; occasionally on the flat side of a board fence, sometimes at the base of bushes such as the elder, and sometimes at the ends of swaying branches when the food plant happens to be a tree. The cocoons spun near the ground are often devoured by mice that gnaw through the silken coats to the edible pupa within. Specimens which had been thus destroyed were shown to this Association by Mr. Joseph C. Thompson on Dec. 12, 1889. Cocoons that are placed on tree branches are more safe from the attacks of mice, but are liable to be eaten by woodpeckers.

On January 14, 1888, I saw a downy woodpecker investigating a *Cecropia* cocoon in a white maple, the woodpecker thrusting its bill in and pulling it out of the cocoon quite frequently. After a while it flew to another cocoon a few feet away, but it being on such a small branch it was unable to successfully pick it open, as the branch swayed up and down. It was then plain what a great protection it was to the insects to place their cocoons near the branch ends, though no doubt they are sometimes killed by the swaying of these branches during a storm.

When the woodpecker was gone I cut the cocoon off and found a small hole on its side quite near the branch, where it was easiest to drill because the silken fabric gave way the least to the strokes of the bird. Cutting open the other side of the cocoon, I found that the pupa shell was sucked nearly dry of its contents.

The *Cecropia* cocoons, occurring commonly on white maples, are generally placed near the ends of the long drooping branches, and it will be seen from the foregoing that it is probably the safest situation afforded by the tree. Near my home there is a small white maple that has eight *Cecropia* cocoons on its branches, but only two of them, from their position, can be injured by a woodpecker.

If a woodpecker is successful in making a hole into a cocoon it is nevertheless sometimes disappointed at its contents. I have found a cocoon that contained the tough case of an Ichneumon fly pupa (*Ophion*), which had been drilled in the side by a woodpecker, and then abandoned, leaving the parasite unharmed.

Mr. Davis also submitted the following note:

The tawny thrush or Veery (*Turdus fuscescens*), has not been reported as nesting on the Island, but during the last spring and summer it was not uncommon at Watchogue. Several would often be heard singing at the same time, or be seen walking, hopping or running, for they do all three, along the wood paths and stopping by the way to turn over a countless number of dead leaves for the insects to be found beneath them. In every instance they frequented the edge of the close timber near to some open or half cleared ground, whither they often flew.

On June 26 I noticed a Veery carrying food in her bill, and was thus enabled, after a time, to discover a young bird perched on a log in a thick growth on the edge of a swamp. On July 10, with Mr. Walter Granger, of the American Museum, I heard many Veeries singing, but we were unsuccessful in finding a nest of the second brood.

It seems probable that this thrush has only been plentiful at Watchogue during the past summer, for just as close attention has been given to the district for a number of years, and yet only once before, namely in May, 1891, was a Veery heard singing.

Mr. Arthur Hollick read Notes on Staten Island Clays collected for the World's Fair.

Mr. L. P. Gratacap exhibited berries of *Smilax rotundifolia* and submitted a memorandum in connection with them.

Mr. Gratacap also exhibited drawings from microscopic examination of rocks to which seaweed had been attached, and read the following note:

The great quantity of rock used in constructing the roadbed of the Rapid Transit Railroad along our north shore has introduced upon the island a very representative collection of N. Y. Island rock, including mica schists, gneiss and granite. It serves the double purpose afford-

ing the local mineralogists an opportunity to study and collect feldspar, quartz and mica, with associated garnets and tourmalines and is a suggestion as well of the underlying reefs of archæan metamorphic masses upon which our own island is built, and our geological relationship with New York from whose ledges the rocks have been transported. Wherever these fragments have rolled down to the waters' edge or are so placed as to be inundated by the high tides, a very vigorous growth of the green filamentous seaweed (*Calothrix?*) has appeared. I am not sure that it is more marked than the similar growth over the traps, sandstones and shales which were the previous occupants of the shores of the Island, and which have been somewhat displaced from their intimacy with the waves and currents of the Kill van Kull by these later arrivals, but it does seem to me as if it had developed with interesting rapidity. The schistose flaky character of many or most of these fragments may have conduced to facilitate this luxuriant development; and where, as in the case of granite veins, the feldspar is coarsely brecciated, the interlacing lines of angular definition between the crystals offer a crevice for attachment. As a fact the lamellar fragments are more quickly invaded.

Placing under a microscope flakes of mica, feldspar and quartz, we can see the delicate filaments of the alga penetrating the films of the mica or occupying pits and irregular surfaces of the feldspar with distributed spots of green granules. Sometimes lacunæ or minute cavities, situated a little way within the edge of mica flakes, will be filled with the green spore-like groups. A few rude drawings show approximately some of the phases in this process of investment of the rock by the seaweed.

Cumulative effects have of late been much emphasized, and it is not unlikely that the alternating drying and swelling, from exposure to the sun at low and submergence at high water, of this alga may sensibly determine the duration, as a mass, of the more schistose or friable rocks, when the tiny extensions of this subtle enemy have effected an entrance within their substance.

The American Psychological Association—Met at Philadelphia, University of Pennsylvania, Tuesday and Wednesday, Dec. 27 and 28, 1892. On Tuesday, Dec. 27 there was a business meeting at which the nature of a permanent organization and other important questions will be discussed. The following papers were read:

Errors of Observation in Physics and Psychology; Prof. J. McK. Cattell, Columbia College; Experiments Upon Pain, Dr. Herbert

Nichols, Harvard University; Tactile Estimates of Thickness, Prof. Edward Pace, Catholic University, Washington; Some Experiments Upon the Æsthetics of Visual Form, Prof. Lightmer Witmer, University of Pennsylvania; Investigations of Reaction-times of Various Classes of Persons, Prof. Lightmer Witmer, University of Pennsylvania; History and Prospects of Experimental Psychology in America, President G. Stanley Hall, Clark University; Experimental Psychology at the World's Fair, Prof. Joseph Jastrow, University of Wisconsin.

Wednesday, Dec. 28.—Certain Phenomena of Rotation, Dr. Herbert Nichols, Harvard University; Note Upon the Controversy Regarding the Relation of the Intensity of the Stimulus to the Reaction Time, Prof. W. M. Bryan, University of Indiana; Minor Studies at the Psychological Laboratory of Clark University, Dr. E. C. Sanford, Clark University; Preliminary Notes Upon Psychological Tests in the Schools of Springfield, Mass., Prof. W. M. Bryan, University of Indiana.

Anthropological Society of Washington.—Dec. 20, 1892.—The program of exercises was as follows: Is Simplified Spelling Feasible? (Symposium.) Discussion by Prof. F. A. March, of Lafayette College, Hon. A. R. Spofford, Hon. Wm. T. Harris, Hon. Edwin Willits.

January 3, 1893.—The program of exercises was the following: Is Simplified Spelling Feasible as Proposed by the English and American Philological Societies? (Close of the Symposium.) Discussion by Prof. Lester F. Ward, Prof. Wm. B. Powell, Mr. James C. Pilling, Prof. Benj. E. Smith, Editor Century Dictionary; Dr. Charles R. G. Scott, Editor Worcester Dictionary; Mr. E. T. Peters, Major John W. Powell and Weston Flint. The discussion was closed by Hon. A. R. Spofford and Dr. Wm. T. Harris.—WESTON FLINT, *Secretary.*

The Biological Society of Washington.—Dec. 17, 1892.—The principal topic of the evening was What Should be the Scope and Object of a Biological Society? Introduced by Mr. B. E. Fernow. The following communications were read: Frost Freaks of the Dittany, Prof. Lester F. Ward; Notes on Peach Rosette, Dr. Erwin F. Smith; Destruction of Lichens on Pear Trees, Mr. M. B. Waite; Notes on Apple and Pear *Fusicladii*, Mr. D. G. Fairchild.

FREDERIC A. LUCAS, *Secretary.*

Indiana Academy of Science.—The eighth annual meeting was held in the Capitol Building at Indianapolis Dec. 28 and 29.

There was a large attendance of members and visitors. President J. L. Campbell, Wabash College, Crawfordsville, Ind., presided. The large number of papers entered made imperative the meeting of the Academy in three sections in the afternoon of the first day. These were so constituted that papers on mathematics, physics, chemistry and geology were read in one section; on botany in another; on zoology and anthropology in a third. On the evening of the first day the President delivered his address on The Independence of Liberal Pursuits. The following officers were elected for the next year: President, J. C. Arthur, Purdue University, Lafayette, Ind.; vice-president, W. A. Noyes, Rose Polytechnic Institute, Terre Haute, Ind., secretary, A. W. Butler, Brookville, Ind.; assistant secretary, Stanley Coulter, Purdue University, Lafayette, Ind.; treasurer, C. A. Waldo, De Pauw University, Greencastle, Ind.; auditors, Thomas Gray, Rose Polytechnic Institute, Terre Haute, Ind.; W. S. Blatchley, High School, Terre Haute, Ind. L. M. Underwood, De Pauw University, Greencastle, Ind.; and W. A. Noyes, Rose Polytechnic Institute, Terre Haute, Ind., were appointed program committee. The Academy decided to hold its spring meeting the third week in May in Parks County, Ind., closing with an evening meeting Friday at Terre Haute, Ind.

The following papers were presented: Notes on the Reproduction and Development of *Grinnellia americana* Harv., M. A. Brannon; Evidence of Man's Early Existence in Indiana from the Oldest River Gravels Along the White Water River, A. W. Butler; On the Construction of a Sensitive Galvanometer, Benj. W. Snow; Some Facts as to the Varying Conditions of Rock Deposits as Observed in the Hudson River Beds of Indiana and an Inquiry as to the Cause of the Same, Joseph Moore; A Simple Air Thermometer for the Determination of High Temperatures, W. A. Noyes; Tests of the Torsional Strength of a Steel Shaft, Thos. Gray; An Extreme Case of Parasitism, Robert Hessler; Exhibition and Explanation of a Geological Chart, Elwood P. Cubberly; Local Variations, C. H. Eigenmann; Botanical Field Work in Western Idaho, D. T. MacDougal; The Quaternion Treatment of the Motion of Two or More Bodies Under the Law of Gravitation, A. S. Hathaway; The Electrical Oxidation of Glycerin, W. E. Stone and H. N. McCoy; Notes Concerning Tests of the Purdue Experimental Locomotive, W. F. M. Goss; The Electrostatic Theory of Cohesion and Vander Waal's Equation, Reginald A. Fessenden; On Sulphon-pthaleins, Walter Jones; Quartz Suspensions, Benj. W. Snow; Observations on Glacial and Pre-glacial Erosion at Richmond, Indiana, Joseph Moore; A Modification of Grandeau's Method for

Determination of Humus in Soils, H. A. Huston and F. W. McBride; Experiments with and Phenomena of Vacuum Tubes, R. A. Fessenden; The Extraction of Xylan from Straw in the Manufacture of Paper, W. E. Stone and W. H. Test; The Electro-magnetic Inertia of a Large Magnet, Thos. Gray; The Determination of Chlorine in Natural Waters, W. A. Noyes; Some New Electrical Apparatus, R. A. Fessenden; Thiofurfurol and its Condensation Products, W. E. Stone and Clinton Dickson; On the Construction and Use of a Bolometer, B. W. Snow; On the Determination of Valence, P. S. Baker; An Application of Mathematics in Botany, Katharine E. Golden; On the Fertilization and Development of the Embryo in *Senecio aureus*, D. M. Mottier; Distribution of the North American Cactaceæ (by title), John M. Coulter; *Marchantia polymorpha*, not a Typical or Representative Liver-wort, L. M. Underwood; Notes Concerning Certain Plants of the Southwestern Counties of Indiana, John S. Wright; Spines and Epidermis of the Cactaceæ (by title), E. B. Uline; Preliminary Notes on the Genus Cactus, E. M. Fisher; An Auxanometer for the Registration of Growth of Stems in Thickness, Katharine E. Golden; The Apical Growth of the Thallus of *Fucus vesiculosus*, D. M. Mottier; Symbiosis of Orchidaceæ, M. B. Thomas; Notes on Pediastrum, W. L. Bray; The Genus Corallorhiza, M. B. Thomas; Notes on Root Tubercles of Indigenous and Exogenous Legumes in Virgin Soil of the Northwest (by title), H. L. Bolley; Notes on Archæology in Mexico, J. T. Scovell; Notes on the loss of the Vomerine Teeth with Age in the Males of the Salamander, *Desmognathus fusca* (by title), F. C. Test: Modern Geographical Distribution of Insects in Indiana (by title), F. M. Webster; New Species of Indiana Hymenoptera, reared at LaFayette, Ind. (by title), F. M. Webster; Description and Elevation of Mount Orizaba, J. T. Scovell; The Climate and Glaciers of Mounts Orizaba and Popocatapetl, J. T. Scovell; A Mite, Probably *Hypoderas columbæ*, Parasitic in the Pigeon, W. W. Norman; The Locustidæ of Indiana with Description of New Species, W. S. Blatchley; Early Stages in the Development of Cymatogaster, C. H. Eigenmann; Some Remarks Regarding the Embryology of Amphiuma, O. P. Hay; Some Structural Peculiarities of Pacific Slope Fishes (by title), A. B. Ulrey; Peculiar Death of an Oriole (by title), T. B. Redding; The Range of the American Crossbill (*Loxia curvirostra minor*) in the Ohio Valley, with Notes on its Unusual Occurrence in Summer, A. W. Butler; A Note on *Loxia curvirostra*, W. S. Blatchley; Notice of a Terrapin to be Restored to the Fauna of Indiana, O. P. Hay; A Migration of Birds and one of Insects, T. B. Redding: The South American Catfishes Belonging to

Cornell University (by title), E. M. Kindle; Notes on the Genus Lytta, W. P. Shannon; The Ichthyologic Features of the Black Hills Region, B. W. Evermann; Explorations in Western Canada, C. H. Eigenmann; Ancient Earthworks Near Anderson, Indiana, Francis A. Walker; The Work of the U. S. Fish Commission Steamer Albatross in the North Pacific and Bering Sea in 1892, B. W. Evermann; A Thermo-regulator for rooms Heated by Steam, J. C. Arthur; Archæology of Tippecanoe County, O. J. Craig; Some Indian Camping Sites near Brookville, A. W. Butler; Relation of Kings County Traps to those of Cumberland County, N. S., V. F. Marsters; The Traps of Red Head, N. B., V. F. Marsters; On Birds in Western Texas and Southern New Mexico (by title), A. W. Butler; An Account of Vegetable and Mineral Substances that Fell in a Snow Storm in LaPorte County, Jan. 8–9, '92 (by title), A. N. Somers; How a Tendril Coils, D. T. MacDougal; Remarkable Prehistoric Relic, E. Pleas; The Brun's Group of Mounds, H. M. Stoops; Some Points in the Geology of Mount Orizaba (by title), J. T. Scovell; Two-ocean Pass (by title), B. W. Evermann; The Blattidæ and Phasmidæ of Indiana, W. S. Blatchley; Forestry Exhibit of Indiana at the Columbian Exposition, Stanley Coulter; The Yolk Nucleus, J. W. Hubbard; Some Causes Acting Physiologically Toward the Destruction of Trees in Cities, J. C. Arthur; British Columbia Glaciers, C. H. Eigenmann; A State Biological Survey—a Suggestion for Our Spring Meeting, L. M. Underwood; The Mounds of Brookville Township, Franklin County, Ind., H. M. Stoops; How the Colleges could aid the Public Schools in Teaching Biological Subjects, W. W. Norman; Notes on the Flora of the Chilhowee and Great Smoky Mountains, Stanley Coulter; The Need of a Large Library of Reference in Cryptogamic Botany in Indiana—What the Colleges are Doing to Supply the Deficiency, L. M. Underwood; Exhibition of a Series of Grouse and Ptarmigan from Alaska, B. W. Evermann; Botanical Assemblies in the United States Announced for the Year 1893, J. C. Arthur; Development of Ovule in Aster and Solidago (by title), G. W. Martin; Remarks on Archæological Map Making (by title), A. W. Butler; The Lilly Herbarium and its Work, John S. Wright; Additional Facts Regarding Forest Distribution in Indiana, Stanley Coulter; Rotary Blowers, John T. Wilken; Some Effects of Mutilation on the Forms of Leaf and Sex of *Morus alba* and *Morus nigra* (by title), A. N. Somers; The Crawford Mound (by title), H. M. Stoops.

SCIENTIFIC NEWS.

What Is an Acquired Character?—I suppose that I am the person to whom Prof. Nutting refers (December, p. 1009) as "the member" who, at the Rochester meeting, "had the temerity to confess that he was not sure that he knew the exact nature of an 'acquired character.'" I have been strongly impressed with the feeling that argument against the position of Weismann and his followers is useless, from the method of these writers in explaining away whatever proofs of the hereditability of acquired characters one may bring forward. The definitions of an acquired character are themselves sufficiently vague and various, but the treatment of individual instances by the Neo-Darwinians seems to preclude the possibility of argument. Prof. Ward has well said that Weismann's "treatment of this point (hereditability of acquired characters) often borders on the dogmatic." The practice seems to be to use the definition as a stalking-horse to shield the philosopher from the onslaughts of his opponents. If he is driven into a corner it is easy enough to say that the character in question is not acquired, but that there existed a predisposition to it; and while he cannot afford any proof of the assertion and may not be able to bring forward any reason for it beyond its convenience as a method of escape, his opponent cannot dislodge him from his position. It seems to me, as I said at Rochester, that much of this argument is but a war of words; and Prof. Nutting has precisely indicated my own difficulties concerning it.

I have been growing plants for a single generation in soils of different chemical composition, the seeds having been taken from the same fruit. These plants show characteristic differences, and when the seeds from the different lots are sown in one soil the resulting plants show that some of the novel characters become hereditary for a generation or more. If I were to bring these experiments forward as proof of the transmission of acquired characters, my opponents would simply say, "Oh, well, these are not acquired characters; there was a predisposition to them."

I may remark here that an inexhaustible field for study of contemporaneous evolution is afforded by common cultivated plants; and if we are to consider acquired characters in the Darwinian sense, I fancy that no one could long be a horticulturist without becoming a confirmed believer in their transmission.—L. H. Bailey, Cornell University.

The Geological Survey of Alabama.—The Legislature four years ago reduced the tax rate, unwisely, as now appears, for it has caused the money in the treasury to run now about $200,000 short of what is needed to carry on the affairs of the State. When the present Legislature met and was confronted with this deficiency in the treasury, the first thought was to reduce the expenses of the State within the present income by retrenching in every direction. Accordingly a number of bills were introduced aiming to cut off everything that we could possibly do without. Among these bills was one prohibiting the payment of any money to the survey for the next two years, saving $15,000 on this item. Many of the members both of the House and of the Senate were disposed to support this wholesale retrenchment if by it the raising of the tax rate could be avoided; for the raising of the rate would be an unpopular measure as a matter of course, and would be made the most of by the enemies of the party in power. Upon closer examination it has become perfectly evident to every one that the tax rate must be raised, for all the retrenchment proposed and in any way possible will fall far short of remedying the trouble. But some of the members are afraid to vote for raising the rate without, as an offset, voting to cut down every expense in the State to its minimum. While it is not likely that the extreme measures at first proposed will pass, there may have to be some compromise that will cut off part of the sum usually coming to the survey. There is no one fighting the survey, for the sentiment is very favorable to us, but they may have to show that they have economized.—EUGENE A. SMITH.

Recent Deaths.—John Obadiah Westwood, M. A., F. L. S., honorary president of the British Entomological Society, died January 1. Prof. Westwood was born in Sheffield in 1805. He was educated at Litchfield and was appointed in 1861 to the professorship of zoology founded at Oxford by the munificence of the late Rev. F. W. Hope.

In 1855 the Royal Society awarded him one of the royal medals for his scientific works, and in 1860 he was elected to fill the place of the illustrious Humboldt as corresponding member of the Entomological Society at Paris. He wrote "Introduction to the Modern Classification of Insects," "Entomologists' Text Book," published in 1838; "British Butterflies and Their Transformations" in 1841, and a number of other works of a similar nature. The number of his memoirs on special groups of insects is large, and he introduced many important forms to the scientific record.

Prof. J. G. Joessel, of the University of Strasburg, is dead. He was born April 27, 1839, and was ordinary professor of anatomy.